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Distribution of Soil Pressure as Related to Foundations

By Daniel E. Moran

Large Timber Frame to Support Concrete Truss Forms

Los Angeles theatre will have 126 ft. proscenium trusses for which heavy platform has been built.

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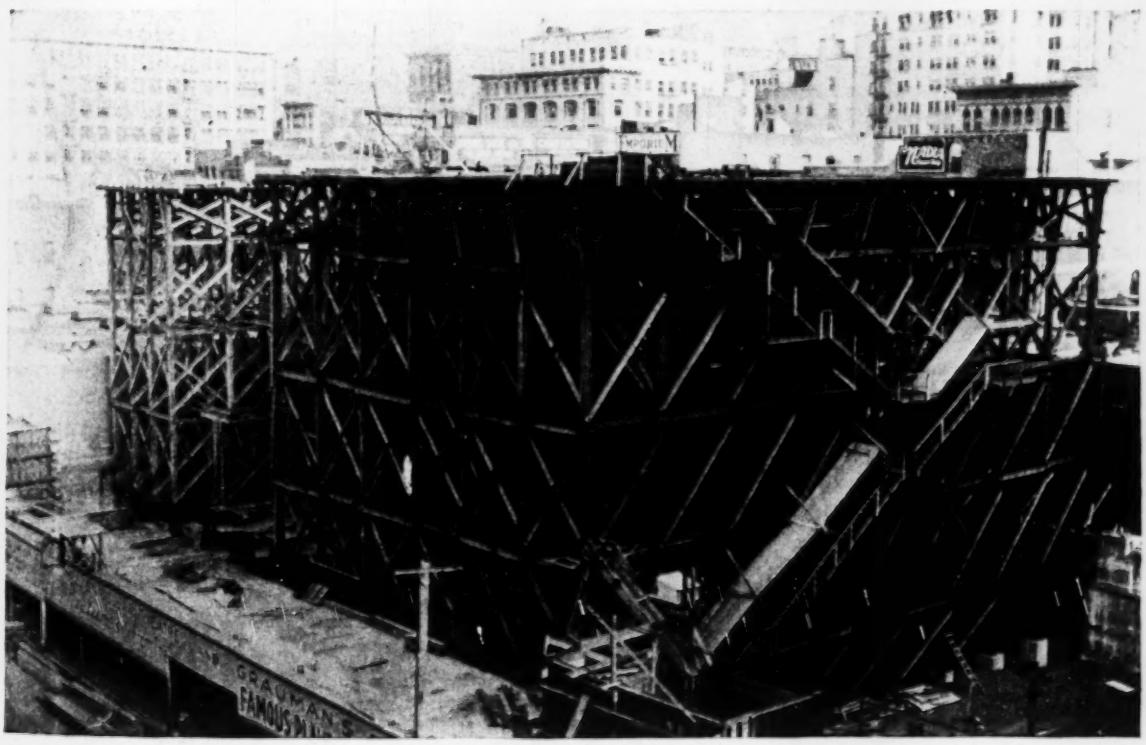

Timber Framework to Carry Forms for 126 Ft. Concrete Trusses on Los Angeles Theatre Building

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. McCAUSLAND, Editor

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An Engineer in the Cabinet

FOR ENGINEERS no public event of recent years can compare in importance with Mr. Hoover's entrance into President Harding's cabinet. He has been selected, it is true, not because he is an engineer, but because he is Hoover—that exceptional combination of remarkable qualifications that has given him a deserved international reputation. Nevertheless, he is an engineer; he has the engineer's method of thought. His selection will help much in fixing a higher place for the engineer in the public mind.

Mr. Hoover's selection is to the engineers of trifling significance compared with its importance to the nation. He adds to the cabinet a very great strength. He comes to heavy national responsibility with a record of previous great national service—as Food Administrator during the war—and with those other remarkable records in the feeding of Belgium, the saving of Central Europe after the Armistice and his latest work, of raising $33,000,000 for European relief. This is an administrative record probably without parallel in the life of a single individual. Of this, the nation is fully aware, and Hoover will therefore carry into the cabinet a great measure of public confidence.

It may be thought that for such a man the secretaryship of commerce is too minor a post. In the sense that Mr. Hoover is eminently qualified for the biggest and most difficult place in the cabinet that is entirely true. Yet we believe that Commerce offers a most extraordinary opportunity, and one that Mr. Hoover, with his vision, will make the most of.

Despite the obvious fact that the nation can live only through agriculture, industry and commerce we have done only an infinitesimal amount to aid the two latter activities. Toward agriculture there has been a somewhat more intelligent policy. The Department of Commerce has been of only recent erection (1903). Before that time its work was done by weak bureaus, and since its elevation to department rank its activities have been far from commensurate with the place that industry and commerce hold in the nation's life.

It would seem to be the duty of such a department to sense the philosophy of American business practice, to learn its advantages, to find its defects, and to spread these so dramatically before the public that there would be a general maturing of our practice, a wider adoption of that which is good, a concerted effort to eliminate what is wasteful or wrong.

Just this sort of thing Mr. Hoover has initiated in the "Wastes in Industry" survey which he initiated and which, under his direction, is being made by the Federated American Engineering Societies. Surely here is a grasp of the significance of industry to the nation that not only gives assurance, but constitutes proof, of what Secretary Hoover will do with the Department of Commerce.

To illustrate further it is worth while to point to the liaison which has existed between government and business in England. To that liaison is due in goodly measure her trade supremacy. Her diplomacy is but a forerunner of business. Her international policies are framed with trade considerations always in mind. The connection of business with the prosperity of the individual is a subject of constant governmental consideration. Therefore, support for business at home is no less strong than for export trade.

Germany's governmental attitude was similar, both toward domestic and export business. There, for example, the trust was not discouraged, but the people were protected from its abuses. Again, statistics were gathered in enormous volume that there might be available the figures needed for intelligent business direction.

We cite these examples not because Mr. Hoover will follow either an English or a German model, but to indicate by contrast how little, relatively, has been our governmental consideration of business. Nevertheless, business is the central material fact of the lives of over half of our people. Agriculture dominates the lives of the remainder.

While, therefore, we realize that the commerce portfolio is well down the list, as the importance of cabinet places is usually ranked, we look on it as a great opportunity. So, without doubt, does Mr. Hoover, or he would not have accepted it. With his vision, his business acumen, his appreciation of the psychology of the American people, his extraordinary administrative ability, we are justified in expecting results of very material advantage to the nation.

Teamwork in Government

SINCE we have empasized administrative ability so strongly in the preceding remarks, we cannot refrain from commenting on one striking feature in the change in our national administration this week. It marks the end of the lone-hand and apparently the return to teamwork in federal administration. The incoming President's selection for cabinet places of two men, at least, who are distinctly greater than himself in intellectual stature and all-round ability—Hughes and Hoover—is a sign of administrative sense that is distinctly encouraging. And we need encouragement today in thinking about our government—our inefficient, war-disrupted government. Business has largely recovered its poise. The government has not. It needs teamwork, strong teamwork to bring back order, efficiency and economy.

Another Call for Research

WHEN PRACTICAL MEN become dissatisfied with methods supplied them by the existing science of their subject, something is likely to happen. So, when a foundation builder like Daniel E. Moran points out the serious shortcomings of the theory of foundation resistance as we have it today, we may conclude, first,

that theory is indeed backward, and second, that the demand for a better science has reached the point for action. The former conclusion has been pointed out in these columns more than once within the past few years. The second conclusion means that a new epoch of foundation and soil study is just ahead. At present we produce many unsafe foundations and very many wasteful ones—wasteful because they do not make use of the resisting power of the soil, for lack of a satisfactory measure of this resisting power and for lack of theory to correlate test and structure. Progress must base on research of two kinds, experimental study of soil properties and analysis of foundation stresses. Such research faces great difficulties, but the problems at issue are of such wide importance that it may well engage our ablest investigating minds. What Mr. Moran has to say in criticism of present knowledge constitutes an urgent call for this research.

Bonding Operating Expenses!

REGARDLESS of the efforts of the Western Society of Engineers, various civic organizations, and the principal newspapers, Chicago, on Feb. 22, voted favorably on an $8,000,000, 20-year bond issue to pay current expenses incurred mostly during 1920. The limit of revenues for corporate purposes (running expenses) is set by the state legislature but the present deficit of about $7,700,000 was deliberately created by over-expenditures in the various departments. Short-time notes might have been issued but the voting citizens of Chicago prefer to saddle the debt onto their successors for 20 years. The 5-per cent interest rate will probably be augmented ½ per cent by the discount at which the bonds will have to be sold. Another deplorable fact is that the city's bonding limit, if all bonds authorized previous to this issue were sold, is only $4,400,000. In consequence other issues for permanent improvements must be postponed and the city is left with no reserve borrowing power. All talk about the iniquity of long-time bonds for short-lived roads pales into insignificance in comparison with the issuance of these long-time issues for deficits incurred for departmental salaries and current expenses.

Sustained Engineering Publicity

THERE are many means by which the engineer's place in our industrial and social scheme can be impressed upon the public. Quite a few are comprehended under the term "publicity," and these were the subject of a conference held under the auspices of the American Association of Engineers in Chicago last week. "Publicity" includes not merely the publication of articles in newspapers and in the general magazines, but such activities as public addresses, school lectures, moving picture films, and other media through which the story of the engineer and engineering can be carried to the popular mind. At Chicago chief discussion was directed toward the use of the newspaper for this purpose. It was agreed that the most effective method was by establishing contacts by local engineers with the local newspapers. However, unless the local publicity agent gets assistance from a national bureau, his activities are apt to cease with the getting into the papers of a few desultory notices of meetings. As the start of a national plan it was suggested that there be appointed by local societies publicity agents in forty of the larger cities to whom a central publicity bureau would send newspaper material each week. In a preliminary way the American Association of Engineers is doing this. The plan is worth expanding. Eventually there should grow out of the effort a manual of engineering publicity from which the local publicity committee and its individual representatives could learn how its work could best be done, what constitutes news, how to interest the editor of the local newspaper, how to prepare matter for newspaper use, etc. The good to be accomplished is so great and so obvious that it is hoped that something tangible will result from the Chicago discussion.

Relief for the Railroads

PAYMENT to the railroads by the Treasury Department of minimum amounts due them by the Government has been assured by the President's signature to the Winslow bill. There has been noted in these columns the serious condition of railroad credit due to the ruling of the Treasury Department against partial payments of amounts due the carriers covering the guarantee period from March to September, 1920, based on minimum acknowledgment of indebtedness by the Interstate Commerce Commission. With at least $300,000,000 due to the railroad companies and with the falling off in traffic, there was little wonder that the prospect has not been bright for new construction on a large scale, since a great many of the companies were unable even to pay current bills for maintenance materials. Although the railroad labor unions attempted to influence the President to veto the bill, it has become law, so that this "frozen credit" that has impaired many lines of business may be released. As pointed out by Senator Pomerene, it was merely a question of immediate payment of acknowledged debts pending the settlement of claims for larger amounts. With this legislation a potent argument against going ahead with needed railroad work has been removed. It is probable that a goodly part of the money will go into improvement work.

Cost of Reproduction

A DECISION at least temporarily barring evidence of physical value and cost of reproduction has been rendered by the Grand Trunk Arbitration Commission in determining the settlement between the stockholders and the Canadian Government, as noted week before last. When it was decided that the government must take over the Grand Trunk properties, an unusual situation was apparent in the problem of reparation to the owners, namely, that the value of the property as a going concern, based on earning power, was very much less than either cost of reproduction or investment value.

If deductions may be drawn from actions of the United States Supreme Court, the decision is in a fair way to be reversed, compelling the admission of evidence of physical value as well as other elements of value. Regardless of the fact that many portions of the Grand Trunk cannot be expected to pay for some time, they represent potential earning power, through actual investment in territories that may develop profitable traffic. Therefore, we believe it reasonable that the commission should at least admit evidence of physical value as developed by the engineers. A ruling which entirely bars such evidence certainly is arbitrary.

Labor Federation's Latest Declaration

WHEN 4,000,000 American citizens speak through a single organization, or, since that is closer to the case, when their officers speak presumably for them, the views warrant the attention of the entire country. Last week the American Federation of Labor issued a statement of its position, and appended a "bill of rights." Like the similar statement made in December, 1919, the document is a disappointment.

Its central idea is that the federation is standing today for the protection of fundamental American rights. It is fighting, so the statement runs, two enemies—reactionary employers, on the one hand, and Bolshevistic influences and propaganda on the other. It protests against profiteering, against a method of industrial organization that has produced the present widespread unemployment, against industrial courts as arbiters of labor difficulties, against misuse of the power of injunction, and declares that trade unions have justified their existence by (1) making collective bargaining possible, (2) rescuing labor from autocratic domination, and (3) developing for the workers a standard of living and working conditions "fitting to American citizenship." It says, "Labor is anxious to serve. It has made this declaration repeatedly. It has lived and practised that determination. It has done this in the face of most wanton and brutal opposition."

So, in brief, runs the document. Its reading, however, leaves one with the impression that while working against forces sinister to labor and to the republic, the federation is placing the public in a decidedly secondary position, and has written an argument that, by emphasizing glittering generalities, will win support for its demand for "rights," but without committing the federation to the discharge of any responsibility. In fact, in the summary which closes the document, and which we have a right to assume includes all important features of the program, nothing is said about the interests of the public; on the other hand there is a demand (a) for "rights" and (b) for *freedom from responsibility*. Had the obligations to the public occupied a prominent place in the program, the leaders would not have emphasized their selfish aims to the exclusion of their public obligations.

The document, strangely, indicates also that the leaders realize the value of public support. However, in order to have a permanent hold on the sympathy of the American people the labor leaders must have a program in which responsibilities are as prominent as rights and must demonstrate, through the actions of their locals, that while striving for selfish ends the public also is to be benefited.

The day after the declaration was made public the federation formulated plans to lay its case before the American people. If newspaper accounts are to be believed, as much as $1,000,000 may be spent on this publicity. Before that campaign is mapped out, we hope that a "bill of responsibilities" will be drafted to go with the "bill of rights," and that the leaders will address themselves to a hard-headed presentation of the benefits of the labor movement to the country at large. Such an earnest study of the problem would reveal to the thoughtful among the leaders the serious weaknesses of the federation's present program and propaganda, and might lead to the formulation of plans that would so evidently redound to the benefit of the public as to win for the federation the coveted widespread public support.

Shall the Engineer Arm Be Recognized in Army Promotions?

ENGINEERING service in the World War will, in all probability, receive no recognition in the form of promotion to general rank unless engineers and engineering societies throughout the country bring their influence to bear on an immediate Army situation. Under the Army Reorganization Act twenty-six vacancies were created in the rank of brigadier-general. Through the President the Secretary of War sent to the Senate nominations which failed to include the name of a single engineer-officer who had been engaged in the performance of engineer duties with the A. E. F. in France. It is true that the list included former members of the Corps of Engineers who had been engaged on General Staff work, but no recognition was given to the personnel which was responsible for building our docks, railroad yards, storage depots, highways, bridges, and a wide variety of other works which were distinctly engineering in character. The Senate refused to confirm the nominations and action now falls to the incoming administration. The subject then will be reopened.

It is, of course, impossible to predict whether or not the same nominations will be offered after March 4. To be sure, however, that engineer officers will receive recognition for engineering work well done, it is necessary that the members of the profession exert themselves. Failure to recognize the engineer arm in these promotions is plain notice to the country of failure to appreciate the place that that arm holds in the conduct of modern warfare.

There exists no dearth of qualified engineer material for this increase in rank. In our opinion it would be a grave injustice to pass by such men as Col. Edgar Jadwin, formerly director of construction and forestry of the A. E. F., and in charge of the huge building program in the Services of Supply in France, and Col. Mason M. Patrick, originally chief engineer of the lines of communication in France and later promoted to become chief of the air service of the A. E. F., which he reorganized from a confused, inefficient organization into an effective, smooth-running machine. The former was a brigadier-general, the latter a major-general.

Promotion to general rank should be based on proved ability in actual service. In the A. E. F. the engineer branch was the largest of any of the so-called technical services, having a personnel of 175,000 officers and men. Both on the grounds of demonstrated qualifications for promotion, to say nothing of representation on a numerical basis, officers with such records as engineering administrators should receive promotion if justice is to be done. As a matter of fact, up to the present time neither of these officers has been promoted or recognized beyond the routine procedure of the War Department. Many others whose commands were smaller in number, whose responsibilities were less, have been advanced to the grade of brigadier general.

Largely through the apathy of the engineering profession the outgoing administration at Washington has been able to take action in many instances detrimental not only to the Corps of Engineers but to the profession at large. If the lesson of the past is to be learned, engineers as individuals and in their society organizations should communicate at once with their senators and with the new Secretary of War to the end that in making the promotions to brigadier-general engineers may receive what is their due.

Distribution of Soil Pressure as Related to Foundations

A Study of Foundation Resistance and Soil Stresses with Discussion of Pressure-Gage Measurements—Amount of Minimum Surcharge—The Direction of Future Progress

By Daniel E. Moran
Of Moran, Maurice & Proctor, Consulting Engineers, New York City
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SCIENTIFIC study of foundation problems, after remaining virtually stationary since the time of Rankine, has in recent years made a promising start with experimental study of soil pressures under loads. Rational thought on the subject has not developed to any extent, however, and the writer desires to present some considerations to stimulate such thought.

That the problems most actively discussed are really secondary is exemplified by the many opinions expressed on the question of how to calculate the bending moment in a projecting wall footing. The two competing formulas for such calculations differ in that one requires part of the wall load to be concentrated at the face of the wall, while the other assumes the wall to rest on its footing with uniformly distributed pressure. As the writer had occasion to show some years ago (in a chapter on foundations contributed to Kidder's "Architects' Pocket Book," 16th ed.), both are necessarily in error, and the truth is to be sought about halfway between their results. However, the greatest possible errors of this kind are negligibly small in comparison with the error (or uncertainty) involved in the universal assumption that the reaction of the soil is uniformly distributed across the width of the footing.

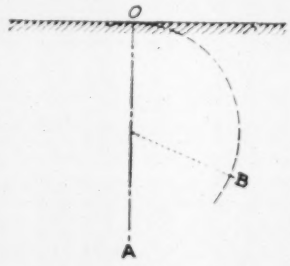


FIG. 1. STRESS CIRCLE IN SOIL.

This assumption would be true for a footing supported on a fluid, or on a material acting as a fluid, but it is *not* true, and indeed is very far from the truth, in the case of a granular material, or rock. Experimental results and theory show that the pressure is greatest at the center of the footing and least at the edges. The bending moments, therefore, are much lower than those calculated by any of the formulas referred to.

The great importance of a knowledge of stress distribution in soils does not lie in the detail question of bending moment, but in the general problems of constructing safe and yet economical foundations. Before any precise planning of foundations is possible for a particular case, the laws of stress distribution in the material forming the foundation bed must be known at least qualitatively.

This requirement can not be avoided by selecting the foundation material. The location of a structure is generally determined by considerations other than the character of the material forming the foundation bed on which the structure must depend for support and consequently the material may be any one of the natural deposits forming the earth's crust.

It may be said in general that when rock is found it will act as an elastic solid; that when water, or soft clay, or granular material containing more water than can be held in the voids of the material, is found, they will act as a liquid; that when granular material such as sand is found it will follow certain laws governing elastic material and also other laws peculiar to granular material.

Pressure Concentration on Rock

When a footing rests on rock, the case may be properly considered as a load on a restricted area on the top surface of an elastic body of large dimensions as compared with the area loaded. Theoretical analysis has shown that the unit stresses in the rock under the center of the load are greater than at the edges. (Love, "The Mathematical Theory of Elasticity".) While the allowable unit loading on rock is high, spread footings are often necessary under the limitations of loading fixed by building departments; if proper account were taken of the concentration of loading under the central part of the footing, grillages and the like could be dispensed with in most cases, and simple pedestals of small size substituted.

Experiments show that the unit crushing load for a limited area of loading, central to the top surface of a cube, exceeds the unit crushing load for the entire top surface. From this we are justified in concluding that an area covered by a footing is reinforced by the surrounding rock to the extent that it would be if the rock mass were a cube with a top face equal in area to the area disclosed by the excavation. Exceptions should be made if the rock is seamed, faulted or in thin beds.

As an example (taken from the author's recent experience) take the case of a column load of 5,000,000 lb. resting on a billet base approximately 44 in. square, or 2,000 sq.in. in area, under which there was provided a two-layer grillage weighing approximately 10 tons, designed to distribute the load over a rock area of 8 x 8 ft. at 40 tons per sq.ft. The rock was of good quality and if a cube 8 ft. in each dimension were tested on an area of 2,000 sq.in. at the center (corresponding to the use of the billet alone) it undoubtedly would develop a unit crushing strength on that relatively small area of over 15,000 lb. per sq.in., or 30,000,000 lb., or six times the load. The writer is therefore forced to the conclusion that in this, and in many other cases where grillages are used to distribute column loads on rock, the only value of the grillage is to meet the requirements of municipal building codes; and that in general a pedestal, rather than a grillage, should be used on rock, or material which can be counted on as an elastic solid.

A still more remarkable instance, the use of a distributing girder on rock, came under the author's observation this year. In the reconstruction of a building two new columns were to be placed close to existing walls, the walls being about 40 ft. apart. A shallow trench was dug to rock and a reinforced-concrete girder

about 4 ft. wide, 6 ft. high, and 40 ft. long was constructed. The column bases were placed on the extreme ends of the concrete girder. The girder was designed to distribute the load of the two columns over a bed of solid rock not less than 4 ft. wide and 40 ft. long. The figured unit load on the rock could not have been over 200 lb. per sq.in., but on the concrete close to the vertical sides and ends of the girder it was undoubtedly 500 lb., the limit allowed by the building code. The construction would have been much safer if the column bases had been placed 6 ft. deeper, directly on the rock, at any unit load which would have been allowed by the building department. At 40 tons per sq.ft. (building department allowance on rock) the footing for each column would have required possibly 32 sq.ft. area; at 4,000 lb. per sq.in. a pedestal 27 in. square would have sufficed.

Non-Uniformity of Pressure in Sand

Similar anomalies in practice sometimes arise in connection with foundations on soil or granular material, but our lack of knowledge concerning stress distribution has here much more serious results. The vital relation of minimum surcharge to bearing capacity is involved both in loading tests and in actual foundations, and we appear to be largely in the dark as to the relation between settlement, load and footing design.

There has been much discussion lately as to the distribution of stresses in granular material, and various experiments have been made with the object of determining experimentally what these stresses are. However, when a mass of sand is subjected in a laboratory to loading tests, the results may differ from actual field results, due to the fact that the sand is confined in a bin of relatively small dimensions; that the proximity of the bottom and sides of the bin to the apparatus measuring the loads may, and generally does, influence the distribution and measurement of the stress; and finally, that the sand is not as compact as it is generally found in nature. Proper interpretation of the test results is therefore difficult.

In what are probably the most reliable tests, Goldbeck pressure cells were used. Various tests have been reported, notably by A. T. Goldbeck himself (Proc. Am. Soc. for Testing Materials, vol. 17, 1917, pp. 650, 651). Goldbeck's tests, and others contained in the report of the committee on Bearing Value of Soils of the American Society of Civil Engineers (Proc. Am. Soc. C. E., Aug., 1920), and still others in the second progress report of the committee on Stresses in Railroad Track (Proc. Am. Soc. C. E., Feb., 1920) establish the general character of the curves showing the vertical components of the stresses for horizontal planes below a loaded area. In the following illustration of experimental determinations of the stresses in granular material (Fig. 3) the writer has reproduced, with slight modifications as to scale, curves given by Goldbeck, with, however, the addition of a curve necessary to complete the series, which was deduced by the writer from the original curves. Curves *G* are taken directly from Mr. Goldbeck's article, the one marked *G int* is the interpolated curve.

Present Theory Faulty

In this connection reference should be made to an interesting study of stress distribution in granular material by Prof. M. L. Enger in the track stress report cited. Prof. Enger gives curves for the observed distribution of stresses in granular material due to loaded railroad ties, and also theoretical curves based on Rankine's theory of the relation of pressure in a granular mass devoid of cohesion ("Applied Mechanics," 16th ed., p. 220), combined with the assumption that "friction between tie and ballast develops pressures which are not vertical." It is interesting to note that Rankine himself, in discussing the application of this theory to a footing resting on granular material, says that

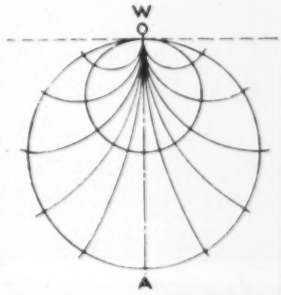


FIG. 2. STRESS TRANSMISSION FROM SURFACE LOAD

$$\frac{p}{wx} = \left(\frac{1 + \sin\phi}{1 - \sin\phi}\right)^2$$

is "the limit of the ratio in which the weight of a building exceeds the weight of the earth displaced by it *when the pressure is uniformly distributed over the base.*" Using the same theory Prof. Enger finds that the pressure cannot be uniform, but must increase from the outer edge of the tie toward a maximum at the center. It seems as if Prof. Rankine had made the assumption of uniform pressure, when he had in his own reasoning the theoretical means to disprove the assumption.

From the most casual inspection of Goldbeck's tests it may be seen that the assumption of uniform stress distribution in the material underlying the footing is untenable. It must be replaced by one based on the fact that when a footing is loaded the stresses in the natural granular material underlying the footing are greatest at the center and reduce to a minimum at the edge of the footing and one which also recognizes the well known fact that there is, in general, a tendency for a lateral movement of material away from the axis of the stress, which tendency may result in an upheaval of materia. at the side of the footing. There has been much discussion and misapprehension in this connection. The writer believes that the stresses in granular material under a loaded footing follow certain simple laws, and that the apparently conflicting or indeterminate results obtained by different experimenters will be readily reconciled and understood if we first have a conception of the theoretical distribution of the stresses.

Behavior of Sand Under Load

In considering a granular material such as sand we must recognize that under stress various things may happen:

1. Each grain being a particle of elastic material, the entire mass may be consolidated as a result of the elastic deformation of the grains composing the mass.

2. The mass may be consolidated and given a permanent set by crushing (to a greater or less extent) individual grains, permitting a readjustment in the position of the grains.

3. There may be a movement of portions of the mass, as by lateral and upward flow of sand near the edge of the footing.

4. There may be a consolidation of the sand resulting

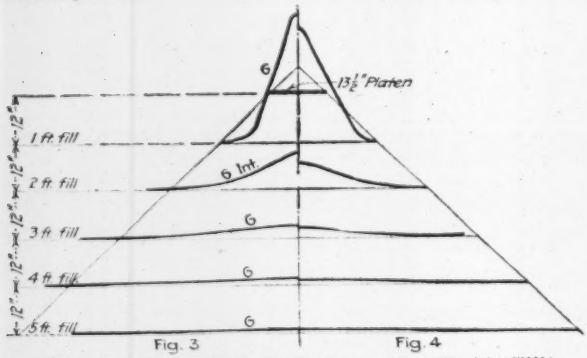
from any readjustment in the position of grains caused by vibration or by movements in the mass.

5. There may be shearing effects due to cohesion between particles of the granular mass.

Before considering the effects of cohesion, elasticity, consolidation by crushing, or other energy-consuming phenomena, it will be well to establish approximately the way in which the static stresses will be distributed in a theoretically perfect granular mass.

Spherical Surfaces of Uniform Stress

Let us assume, for simplicity, that the granular mass is composed of particles irregular in size and shape, devoid of cohesion, elasticity or weight. Let us consider first the distribution of a stress acting in any direction on any point in the interior of such a mass. In Fig. 1, let the stress W, acting in the direction $W A$, be applied at the point O.



FIGS. 3 AND 4. SOIL PRESSURES UNDER PLATEN WITH 5,000 LB. LOAD
Goldbeck's measurements at left. Author's theoretical curves at right.

The writer believes he has succeeded in demonstrating that the resultant stress at any point of the mass in the region between O and A, say at B, will be normal to the surface of a sphere passing through B and O and having its center on line $O A$; and, further, that the intensity of stress will be uniform and equal to Wc/D^2, in which c is a constant having a value about 40. The demonstration may for the present be expressed merely as the necessary resultant of the following principles: (1) That the paths of stress transmission diverge by the effect of the conjugate or lateral pressure which, resulting from hit-or-miss irregularities in grain arrangement, accompanies every directed pressure in a granular material; (2) that this lateral pressure is proportionate to the direct stress; and (3) that the lateral stresses traced around a closed curve must everywhere equilibrate each other. The lateral-stress surface may therefore be regarded as a shell of uniform tangential stress (like a balloon, but with compression in place of tension); and since the normal stress, being proportionate to the lateral stress, must also be uniform, the surface is a sphere.

However, without dependence on the two deductions above stated or their demonstration, it will be obvious that the outward spread of stress from the point of application of the load must occur along curved radiating lines somewhat similar to those drawn in Fig. 2, and the surfaces of equal stress are represented by closed curves which, whatever their precise form, may for the purposes of the present discussion be taken as circular in their lower portions.

The foregoing statement as to stresses is framed to suit the distribution of a stress applied to a point in the center of a mass of granular material. To apply it to the case of a load acting vertically downward on the horizontally-disposed top surface of a granular mass we may pass to Fig. 2, in which W represents a stress along A, perpendicular to the top horizontal plane surface $C D$ of a mass of granular material. Draw through the point of application, O, circles of various diameters each tangent to the line $C D$ at O and all having their centers along the line $O A$; then these circles may be taken as representing the traces or intersections of spherical surfaces with the plane of the paper. It will then be true of any point on any circle that the direction of the stress through that point will be normal to the surface of the sphere, i.e., that the stress will act along the direction of a radius of the sphere drawn to the point; and also that the intensity of the stress will equal Wc/D^2 where c is 40 and D is the diameter of the stress sphere through the point. We may therefore consider the spheres as being contour lines drawn through points of equal stress.

Again, if from any point on the line $C D$ we draw a circle passing through O, this circle will evidently cut all the contour circles at right angles, i.e., tangents to both circles at the point of intersection will be at right angles; and circles so drawn may be taken as indicating stress gradients, i.e., lines of which it may be said that they start from the maximum stress at O and follow a path along which the intensity of stress constantly decreases. The rate of decrease in stress intensity will be less along gradient circles drawn with a large radius than along gradient circles having a small radius, and, moreover, the rate at which the stress intensity decreases will not be uniform along the gradient lines but will be inversely proportional to the number of contour lines cut in a given distance.

In the diagram we may, without modifying the stress conditions, substitute for the theoretical point application an application of stress through a surface, such as the under surface of a circular footing or of a circular platen in a testing machine, *provided* we place in the diagram the pressure-producing surface at a distance below the line $C D$ equal to its half-diameter. In other words, there will be no difference in the stresses produced in the granular material whether the load is applied at the point O or whether it is applied on a circular plate replacing the entire horizontal cross-section taken through the center of any one of the spheres which define surfaces of equal pressure.

Knowing the direction and intensity of stress at any point in the mass we can draw curves indicating the vertical or horizontal components of the stress along any desired line. In order to make a comparison with the experimental results the writer has constructed curves based on the foregoing theoretical considerations, to show the vertical intensity of stress on the planes corresponding to the location of the test planes and the size of the platen used by Goldbeck. The comparison is made in Figs. 3 and 4. It will be seen that the curves are of the same general character.

The Natural Foundation in Sand

What now is the practical conclusion to be drawn from the above theoretical considerations? How will the conditions differ when a natural foundation bed is loaded?

Let us suppose that the theoretical granular material, which we have been considering as being devoid of weight, cohesion and elasticity, suddenly becomes endowed again with its natural qualities. It is evident that under the center of the footing and along a line drawn vertically downward the stresses are greatest, and the effects resulting from the stress, namely crushing and compression of the grains, will be at a maximum; and that these effects will extend to a maximum depth, as compared with the other portions of the mass supporting the base of the footing. The intensity of the stress under the edge of the footing is much less than the intensity at the center and acts on a shorter and more inclined column of granular material opposing the descent of the platen. If there is no general movement of sand such as occurs when there is insufficient surcharge, the energy of settlement (i.e. the work in footpounds developed by the load of the structure moving downward, which is the energy which acts to crush and compress the sand) will result in a slight increase of the stress under the edges of the footing and a slight decrease in the stress under the center.

But if, as in most laboratory experiments, the surcharge is insufficient, the sand near the edges of the footing, being subject to stresses directed outward and upward, will overcome the weight of the insufficient surcharge and move outward and upward. The effect of this movement will be to destroy the supporting value of the sand subject to the movement, and the intensity of the stresses at the center will be increased by whatever amount of support is lost as the result of the sand movement.

The problem in general is, therefore, not only one involving the statical stresses produced in a theoretical granular material, but also one involving the dynamics of crushing, compression and movement of sand.

Effect of Surcharge

Consideration of the theory, however, demonstrates that if the surcharge equals one-half the diameter of a circular footing there can be no stress producing uplift of sand, because all of the contour lines indicating stress are below line *C D*, drawn through a point above the platen at a height equal to the half-diameter of the platen or footing. It is only when the surcharge is less than the half-diameter that we need fear lateral or vertical movements of sand.

When the surcharge, or some substitute for the surcharge such as a concrete floor, prevents lateral or vertical movement the problem reduces itself to one of determining the amount of settlement which will result from elastic compression, crushing and consolidation due to the stresses, possibly complicated by the slight shifting of stresses which must be expected as the result of the greater consolidation along lines of maximum stress. These effects, under any reasonable loading, will be very small—generally negligible—corresponding to the general experience that a footing on sand having a sufficient surcharge settles little.

Stress-strain determinations on sand, made for the writer by A. H. Beyer, Director of Testing, and W. J. Krefeld, Engineer of Tests, of the civil engineering laboratories at Columbia University, indicate that under an applied load of 100 lb. per sq.in. the total compression of Cow Bay sand per inch of length is 0.0049 to 0.0074 in. for sand compacted by vibration to a percentage of voids less than 30 per cent of the total volume. A sand not so carefully compacted, having voids 34.1 per cent of the total volume, compressed 0.0177 in. per inch of length. In the first two cases about 50 per cent of the total compression was recovered on the removal of the test load, so that, roughly speaking, we can say that for loads on compact sand one-half of the settlement is due to elastic compression, the remaining half being due to crushing or other consolidating effects which consume energy but do not produce a continuously effective resistance. In the case of the loose sand a much smaller proportion of the total energy goes to elastic compression.

To make an approximation of the facts in a practical case: While the unit stress under a footing designed on the basis of a uniform load of 4 tons per sq.ft. or 55½ lb. per sq.in. may amount to several hundred pounds per square inch directly under the center of the footing, this stress rapidly reduces in intensity with depth, so that the column of support which terminates under the center of the footing in a small area at high unit-pressure will, at a short distance below the surface, become a column of large area with a low intensity of pressure. The rate of compression due to the high unit pressure can only be figured for a short length of column before it must be reduced to the amount of compression due to a very much lower unit pressure. As the unit pressures vary inversely with the areas, and as the areas increase with the square of the distances, if the amount of compression is (within limits) proportional to the stress then the amount of compression per foot of length will decrease as the square of the distance.

A rational extension of Goldbeck's curves would indicate a center pressure under the platen of not less than 150 lb. per sq.in. The theoretical maximum would be much more. Experimental determinations of the actual stress are greatly to be desired.

The pressure under the platen is at the center more than 150 lb. per sq.in., but at 12-in. depth only 30 lb., at 24-in. depth probably 7 lb., at 36-in. depth 3 lb., at 48-in. depth 1½ lb., and at 60-in. depth less than 1 lb. per sq.in. Thus there is only a short distance in which high intensity exists, and the total compression must be small, probably not more than the amount due to a load of 100 lb. per sq.in. for a length of 2 ft. This applies to a load of 5,000 lb. on a 13½-in. platen.

It would seem from the foregoing that it would be safe to use much higher unit-pressures on sand, i.e., to reduce the areas of support, and also safe to design for much smaller bending moments at the center. The writer has for many years believed that this was the fact and that most failures of footings on sand were due to a movement of the soil because of lack of surcharge or to a general movement due to causes not connected with the design of the footing. Changes in the basis of loadings on sand and of footing design should go slowly and as a result of full confirmation of theoretic and experimental results, however.

Effect on General Foundation Problems

The author has, in this article, attempted to indicate the application of the experimental data, and of the proposed theoretical explanation, to the single example of footing and foundation design. There are many other problems involving earth pressures to which the principles involved may be applied.

The engineering world has been discussing earth pressures on retaining walls and sheetpiled excavations

and earth pressures in general and the belief seems to be gaining ground that the theories of Rankine, Coulomb and others based on the sliding of earth along planes determined by the angle of friction do not correspond with practical experience. Many engineers believe that the maximum earth pressure against a vertical wall is not at the base. This opinion is supported by the present theory.

The movements of soils under pressure and the failures of banks along spherical or cylindrical surfaces have seemed to the author not to be explicable by the older theories but do seem in accordance with the present theory.

A number of interesting conclusions will undoubtedly come to the mind of anyone who has closely followed the foregoing.

IMPORTANCE OF DETERMINING CONDITIONS OF SURCHARGE

It is evidently absurd to speak of any granular material as having a bearing value of a fixed amount, unless the conditions as to surcharge are known.

It is evidently useless to make or compare test loads on sand or other granular material unless we formulate the conditions as to surcharge. If we wish to determine the resistance to crushing and elastic deformation, the surcharge must be of a depth not less than half the diameter of the area tested, and must be well-compacted. If we want to determine whether cohesion or other qualities in the sand will prevent or reduce the movement of sand, we should specify what amount of surcharge should be used.

As ordinary sand under a test load of 1,000 lb. per sq.in. compresses less than 0.05 in. per inch of length, it is evident that sand can be loaded by a properly-designed footing greatly in excess of the conventional 4 tons per square foot, provided a reasonable amount of surcharge necessary to prevent motion can be maintained. It is evident that under the same condition the bending stress in the footing will actually be much less than as calculated by any of the current formulas.

Preferential Power Contracts Subject to Regulation

A decision recently handed down by the Supreme Court of California rules against Hartland Law who contended that the California Railroad Commission exceeded its powers in forcing him to pay the Great Western Power Co. rates fixed by the commission for electrical energy and steam heat, despite the fact that he held a twenty-year contract at a lower rate. The decision settles a dispute of long standing arising from the fact that municipalities and others enjoying special rates held that the commission had no right to disturb a situation in which the holders of long term contracts for utility service enjoyed advantages which resulted in increased cost for the other consumers. The court held that "there is no longer any question as to the power of a state to fix rates for a public utility service which will supersede rates for such service previously fixed by private contracts between the consumer and the company. It has been conclusively settled that the interference with private contracts by the state regulation of rates is but a legitimate effect of a valid exercise of the police power which neither impairs the obligation of a contract nor deprives of property without due process of law."

Local Freight Problem at New York

Extracts from a paper, "The Transportation Problem of the Metropolitan District," by J. J. Mantell, regional manager, Erie R.R., before the New York Railroad Club, Feb. 18, 1921.

COMMENDATION is due the New York-New Jersey Port and Harbor Development Commisison for its untiring efforts and for the valuable statistics, contained in its recent report, some of which were not previously available. While certain concrete and specific recommendations are made, the most disappointing thing is that there is no immediate relief in sight. The principal objection to the commission's plan for the "automatic-electric system," is that it involves an unwarranted expenditure.

The plan is based on the general principle of a moving platform placed underground resembling a railroad but functioning more as a conveyor, linking up the New Jersey railroads by a belt line and building a joint yard or transfer station on the Hackensack meadows. The automatic-electric tracks, starting from this yard and passing under Bergen Hill and the Hudson River, would serve nine or ten multiple-story warehouses covering from four to six square blocks in Manhattan. Who is going to finance the project and how can a facility of this kind be made to pay at an estimated original cost of $240,000,000? It would be confined to only certain kinds of domestic freight: small package freight not including heavy pieces of structural steel, building materials of various kinds, machinery, other heavy articles and particularly coal. It would simply be a small package railroad to release water-front piers.

It is generaly admitted that something must be done at New York. I think it is agreed that we must proceed along lines that will give some immediate relief and plan a gradual development which will reduce the cost of handling freight. Under existing conditions the handling of domestic freight, both from a railroad and merchant standpoint, cannot be done economically. There is pier congestion; there is waiting in line; there is loading and unloading. The average truck in New York is only moving from 25 to 30 per cent of the time. There is duplication in cross hauls.

The problem can be solved and this would be advantageous to both the merchants and the railroads. My recommendation is that we give serious thought to a plan which would provide for the handling of freight from existing and centralized freight stations in New Jersey to warehouses and store-door delivery in New York on practically all carload business, which amounts to at least 40 per cent; creating inland stations in the metropolitan district suitably located in proper zones for receiving and distributing less carload freight. These inland stations would be equipped with specially arranged bodies or containers where the assortment for particular consignees and particular destinations could be made, the stations to be equipped with proper mechanical appliances for prompt handling of these removable bodies to and from tractor trailers. In other words, you can do your business on wheels; keep your motor tractor turning over; increase its efficiency; do away with the waste of rehandling on the railroad and the trucking waste which at present exists in New York, and effect a real store-door delivery. A man today who is operating trucks would be surprised at the benefits, not only the benefits in the line of service that would be derived, but in the decreased cost of handling his goods. This can be brought about by collective effort on the part of the merchants and railroads to demonstrate the practicability of such a scheme.

Canvas Carpet Keeps Truck Body Clean

Using a dry mix, Lee bodies on trucks hauling concrete for road work in Walla Walla County, Washington, were kept clean by a canvas carpet attached to the front edge of the body and covering the entire bottom to the rear edge. Before each new load the body was washed clean with water. Maximum hauls of 9,800 ft. were made in 20 min., 12 min., with load, and 8 min. return time empty. A Guthrie & Co., St. Paul, Minn., were the contractors.

Filter Underdrains, Sand Bed and Wash Water Experience

Discussion of Symposium on the Subjects Published in "Engineering News-Record" of Nov. 11 and 18, 1920

By Malcolm Pirnie
Of Hazen, Whipple & Fuller, New York City

THE "Symposium on Current Practice and Operating Success with Various Details of Mechanical or Rapid Water Filtration Plants" published in *Engineering News-Record*, Nov. 11 and 18, 1920, pp. 934 and 984, is of great interest to designers and operators of filtration plants. It sets forth varied designs for accomplishing the same result, most of which are satisfactory or have been made satisfactory by slight changes. There is no standard design for mechanical filters in spite of the fact that the fundamental laws governing successful designs are identical for every plant, and it is probable that there never will be a standard design because these laws may be obeyed by a multitude of details especially adapted to local conditions. It is essential to have a clear understanding of the performance of a filter bed, both in filtering and in cleaning, in order that the details of construction shall be as simple and cheap as possible and still satisfy the principles governing continuous efficient operation.

When the size and depth of filtering material and rate of filtration have been determined to treat a given water, the filter design must provide for two primary requirements. First, during filtration, the water must pass through every unit of filtering area at a uniform rate; second, the provision for cleaning must be such that the entire bed shall be uniformly cleaned and left uniformly graded at the end of the cleaning operation. In almost every design the first requirement is dependent upon the second, so that a mechanical filter equipped to wash and grade uniformly the filtering material will filter water uniformly; and conversely, a filter not uniformly washed and graded will not filter evenly, and the efficiency during the first part of the run will be considerably reduced. The primary problem is the selection of proper details for supporting the filtering material and uniformly grading and cleaning it.

The next step is to determine the rate of wash water required and whether or not the aid of air agitation of the surface is necessary. The maximum effective wash-water rate depends upon the size and specific gravity of the filtering materials. Uniform washing, when sufficient to suspend the bed, is simply the reverse of sedimentation—the water rising upward past the particles at the same velocity that the particles would fall downward through water in the process of settling. If the rate of wash water is increased above what is necessary to suspend the bed, the particles simply readjust themselves with increased voids, so that the velocity of water passing them remains the same, exerting an upward force on them just balancing their weight. Thus a rate of wash water greater than is required to suspend the bed will not increase the scrubbing action on the individual particles. Therefore, when the size and specific gravity of the filtering material have been selected, a wash-water rate just high enough to suspend the portion of the bed subjected to clogging may be determined. This rate will give the maximum cleansing effect, while higher rates will consume more water and will not clean the bed any faster or better. The higher rates may serve in some cases to carry into the gutters some dirt that otherwise would settle back on the surface after washing, but the expulsion of this dirt should be provided for by restricting the area between gutters in order to increase the velocity above the agitated sand.

Part the Gravel Plays

To produce a uniform wash the water required must be delivered to every unit of area at the bottom of the filter in equivalent quantities and above the bottom there must be sufficient baffling to destroy all eddies and a uniform resistance throughout the entire area must be exerted on the rising water to distribute it evenly at the point where it enters the main filtering material. Furthermore, the filtering material must be supported in such a way that it will not penetrate the supporting and distributing portion of the bed. Gravel support for sand has become almost universal, but there is a wide variation in the sizes, number of grades and depths used. The selection of gravel should depend upon the spacing and size of the unit wash-water inlets which also determine the velocity of the entering stream. If the inlets are large and far apart the gravel surrounding them should be large to avoid clogging the inlets and to allow distribution of the wash water over the areas between them. The final layer of gravel should not be lifted by the maximum rate of wash water, unless the lower grades are sufficient to maintain the uniform rate of wash. Now the first grade of gravel allows the distribution of the wash water through the voids over the entire filter area and begins the baffling action on the eddies created by the relatively high velocities of entrance. The superimposed layers of smaller gravel must introduce sufficient resistance to complete the destruction of eddies and to cause a uniform upward entrance velocity, or at the entrance to the final gravel if the wash rate is high enough to suspend it. This effect can be accomplished only by the most careful grading of the gravel at the time of construction. Each layer must be of uniform material and thickness and absolutely level so that the resistance to the rising wash water will be the same in every part of the bed.

Uniformity Essential

When the bed settles after wash is turned off, there exists a uniformly separated mass of sand with particles of equal size lying in the same horizontal planes, the finest at the top and the coarsest at the bottom. The surface of the bed is absolutely level and is uniform as to color and size of sand. If the wash were not uniform, the surface of the bed after washing would not be level, and there would be apparent dark spots where coarser sand was exposed to view. These spots would mark the places where the upward velocity of wash water was greater than at the other portions of the bed. With the uniformly graded and clean bed there will be a uniform resistance offered to filtration, and the water will pass through all parts of the bed at the same rate; but in beds where shafts of coarse sand have been introduced by an uneven wash, the water will pass through these shafts directly to the gravel and underdrains at a relatively high velocity. Restricting the size of openings in the underdrains to control equal filtration will have little effect, as water piercing the sand bed in spots at high velocities can pass laterally through the large voids in the gravel and enter several openings in the

underdrains. This fact leads to special constructions of filter bottoms to limit lateral flow, such as parallel or intersecting ridges or plate baffles. These cannot be entirely effective in stopping lateral flow during filtration unless they project to the surface of the bed.

The largest proportion of the head lost is in passing through the dirty surface layers, and, if there is opportunity for rapid passage in spots, lateral flow can take place in the relatively coarse lower portions of the sand (although to a less degree than in the gravel). Therefore, the most effective way to insure uniform filtration is to construct the bed so that it can be uniformly washed at a high rate to suspend and clean the sand and leave it uniformly graded. In this case, the strainer system should be designed properly to distribute the wash water without introducing too much disturbance at entrance and the gravel should be deep enough to destroy all eddies.

Perforated-Pipe Factors

The perforated-pipe underdrain system above a plain floor with the perforations on the under side of the pipes is becoming very common. The even distribution of wash water over the bottom is obtained by restricting the size of the perforations to cause a relatively large loss of head at these points of entrance. The main force of the jets hits the floor and is broken. The water spreads out through the voids of the large gravel surrounding them and the superimposed uniform layers of finer gravel introduce the resistance necessary to distribute the rising wash water evenly over the entire area of the bed. This seems to be the simplest way of producing the desired results, but certain special bottoms and upward or lateral discharge strainers have been successful, although requiring deeper layers of gravel, screens or other devices to break up and distribute the entering jets before they reach the sand. The question as to which of many successful designs should be adopted for a given case should be decided on the basis of comparative costs. It is difficult to find a strainer system less expensive than the perforated-pipe design and this has led to its use on a large scale.

Perforated-pipe underdrain systems which lie within the following limits of design have been successful. Throats from 6 to 12 in. apart, all pointed downward. Loss of head of wash water through throats, from 6 to 10 ft. Area of main drains twice the area of all the throats supplied by them and area of lateral piping from 2½ to 3 times the area of all the throats supplied by them. Gravel in the first layer should be about 4 in. thick. It is absolutely necessary that each layer of gravel should be composed of uniform material, should be the same depth over the entire area of the filter and should be perfectly level. Failure to secure the utmost care in placing the gravel means failure in the operation of the filter. Too much importance cannot be given to this fact. The total depth of the gravel bed may be from 16 to 24 in., depending upon the throat velocity selected. These depths might be reduced, but it is better to allow a fair margin of safety to overcome irregularities in construction. The most effective wash-water rate for ordinary mechanical filter sand is between 1½ and 2 cu.ft. per minute per sq.ft. of filter area.

A great many experiments have been made on differnt types of underdrains and supports for the filter bed, and they have been most useful in directing successful designs for large filtration plants. Still more experiments, with wide publicity given to the result are desirable, but it must be borne in mind that it difficult, if not impossible, to secure the same perfectio in the construction of a large plant that it is in the construction of a small experimental unit. Further more, there are conditions existing in a large filter bed that are not duplicated in a small bed. Therefore, it i reasonable to give greater weight to designs that have been in successful operation on a large scale for a number of years than to the results of a relatively short period of operation of an experimental plant. There is still a great deal to be learned about mechanical filter construction and operation, and nothing can be more valuable to the designers than a knowledge of the experiences of the operators of mechanical filters throughout the country.

Physician and Engineer Needed to Control Yellow Fever

By C. G. Wigley

With Clyde Potts, Civil and Sanitary Engineer, New York City

THE final report on Yellow Fever Control in Ecuador, by M. E. Conner, M.D., Field Director International Health Board, contains the following paragraphs that should be of interest to engineers engaged in water-supply engineering in tropical or semi-tropical areas:

As a result of the yellow fever work in Ecuador, it was possible to arrive at certain well-defined conclusions. With the idea that they may be of more than general interest, they are here set down:

The only endemic center of yellow fever in Ecuador was in the city of Guayaquil.

The principal factor in the eradication of yellow fever at Guayaquil was the mosquito-proofing of fresh-water containers, especially tanks.

When tanks are used in homes for storing fresh water, they will be the preferred breeding places of the stegomyia mosquito.

Fish as mosquito-larvæ consumers produce excellent results in barrels and similar containers, and are an economical means of mosquito-proofing this class of fresh-water receptacle. Fish are not recommended for use in tanks, because the latter are placed high up to gain head pressure, and it would be necessary for the inspector to use a ladder whenever he inspected the tank to be sure that the fish were still alive. The necessity of all this extra labor is eliminated by covering and "sealing" the tank. Again, when the water is low in the tank there might not be enough to keep the fish alive.

Yellow fever has been eradicated from Ecuador, and if it should ever again become endemic it would be because it was introduced from a focus outside of the country.

It would seem that this is an additional field for co-operation between the physician and engineer for the greater welfare of the human race. Success in eliminating typhoid fever and cholera has been due to the efforts of physicians and engineers operating more or less separately. In work relating to the control of malaria and bubonic plague they now work together more effectively.

The conclusions given in the quotation lead one to believe that cities in Ecuador need the services of sanitary engineers. In a country having some 50 in. of rainfall per annum it would not seem an impossible task to provide for a city of 60,000 or more inhabitants, a water-supply system in which the objectionable storage tanks would be eliminated. It is believed that by utilizing the machinery and equipment now available such a system could be readily devised.

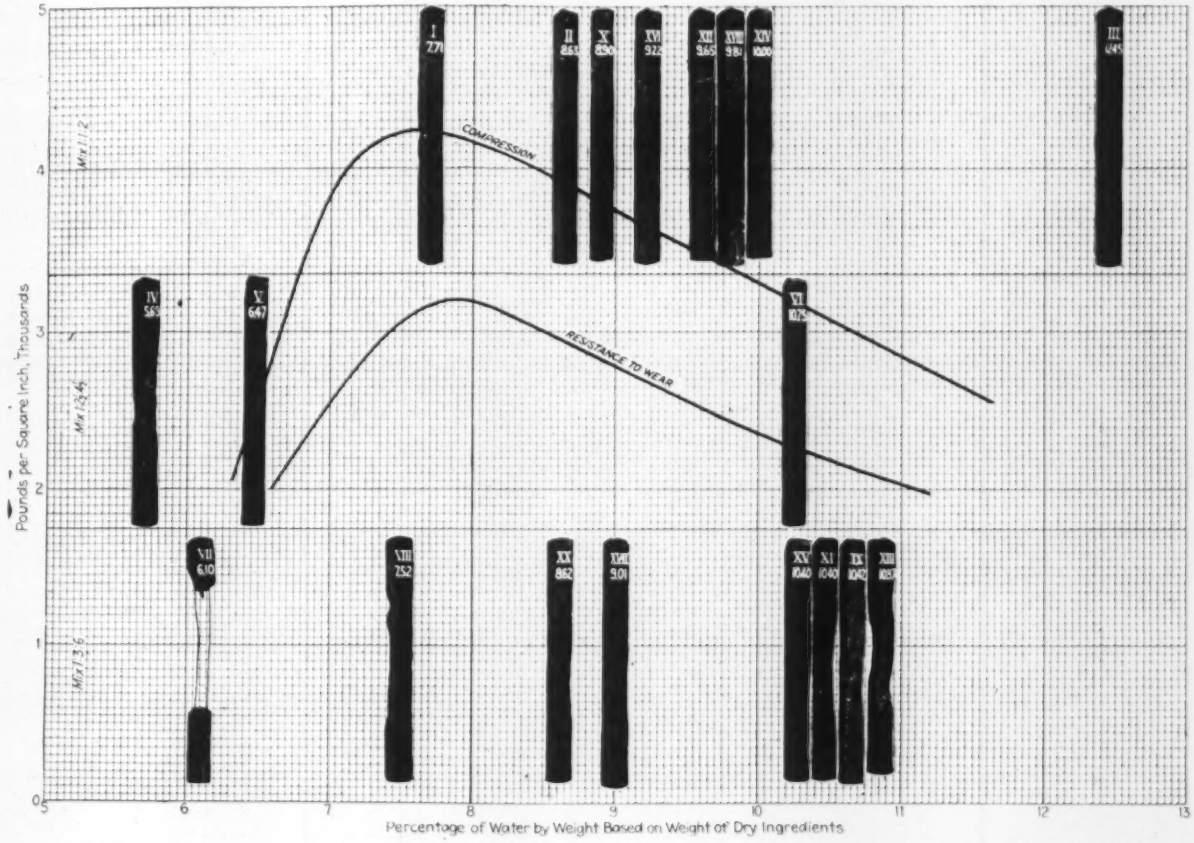
Water Content Affects Wear of Concrete Test Pieces

By Dan Patch
Aserthaw Construction Co., Boston, Mass.

In studying the latest inspection report of the behavior of the test pieces placed by the Aberthaw Construction Co. in Boston harbor in 1909, the effect of water content in concrete has seemed to be important. The accompanying diagram has been prepared to illustrate the results observed; it should be read in connection with the more complete data on the tests published in *Engineering News-Record*, Jan. 20, 1921, p. 121. The photographs of the test pieces as taken from the water in 1920 are re-arranged on this diagram in such a way that the engineering lessons may be best seen. From the data of the mixtures used in making the test piles, each has been reduced to an equivalent percentage of water based on dry aggregate. The photographs have then been arranged by mixes on a scale of water percentages. By this arrangement it will be seen that there is much more variation in any one mix, due to varying the quantity of water used for the mixture, than there is between the mixes at the proper percentage of water.

It is evident from the photographs that in these tests the best percentage of water for a mix to resist the action of the tidal water is from 9 to 10. As the test was not made with an intent to study the effect of the variation in quantity of water used in mixing concrete, it does not lend itself entirely to making such a study, but judging from the excellent condition of pile No. 3 of 1:1:2 mix, the percentage of water to be used for a rich mix may well be considerably higher than for a lean mix.

An interesting comparison is made by plotting through these photographs the typical curves for compressive strength and the reciprocal of the abrasive wear, obtained from data in Bulletin No. 2 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, the tests being made at an age of four months. Considering the age of the specimens photographed, there is a remarkable agreement between the location on the water scale of the maximum resistance to wear and the best specimens of piles.



10-YEAR OLD SEA WATER TEST PIECES ARRANGED ACCORDING TO PERCENTAGE OF WATER IN CONCRETE

Court Decides That City in Washington May Take Water From Oregon

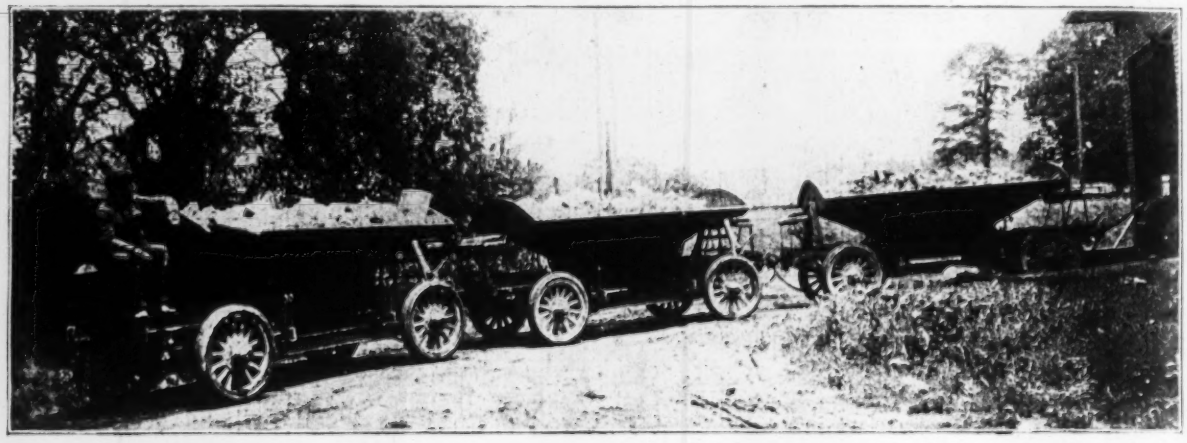
The Supreme Court of the State of Washington has recently decided that the city of Walla Walla may legally acquire property for water-supply purposes in the Wenaha national forest in the State of Oregon. The court was divided 5 to 4 and the decision supported a decision of the lower court. It appears that on Feb. 23, 1909, the Oregon Legislature passed an act authorizing cities in Washington to acquire property for public use within the State of Washington, and that on Feb. 26, following, a reciprocal measure was passed by the Washington Legislature.

Trailers in Municipal Service

How They Are Used for Garbage and Ash Disposal and Street Repair Work — Their Possibilities for Snow Removal Not Yet Fully Developed

By Harry Wilkin Perry
General Manager, Trailer Manufacturers Association of America, New York City

TRAILERS first came into use by cities years ago when fire departments began motorizing their equipment. The old horse-drawn fire engines, ladder trucks and standpipes became motor trailers when first electric and then gasoline tractors were substituted for the horses. Some years ago the street cleaning departmen of the City of New York put into service several huge, specially built semi-trailers for collecting street sweepings. These are drawn by electric and gasoline tractors of the short-wheelbase truck type. The trailers have long, low frames arranged to receive 10 or 12 rectangular steel receptacles in two longitudinal rows. These are easily filled from the sides of the trailers and when the outfit arrives at the dock the receptacles are picked up one by one by a crane and the contents emptied into a barge in the river to be towed to sea and dumped. Although the city has completely motorized its fire department in the last 10 years there has been no further development of or improvement in the street cleaning system of the metropolis. The city recently purchased about 250 motor trucks and tractors for snow removal and other work, but no trailers were included in the contract let.



TRAIN OF GARBAGE COLLECTION TRAILERS AT MEMPHIS TOWED BY TRUCK TO INCINERATOR

Cities Using Trailer Systems—Meanwhile a dozen or more smaller cities have outdistanced the leading cities of the country in the matter of garbage and ash removal. For more than a year the city of Utica, N. Y., has used motor-trailer equipment in this work with results that are highly satisfactory. The Utica system was described and illustrated in *Engineering News-Record* Oct. 30-Nov. 6, 1919, p. 810. Other cities that have adopted the trailer system are Indianapolis, with an equipment of 25 trailers; Bridgeport, Conn., with 16; Syracuse, with 40; Dallas, Tex., with 30; Memphis, Tenn., with a fleet; Norfolk, Va., Cleveland and Akron, Ohio; Detroit and Highland Park, Mich.; Gary, Ind., and Kenosha, Wis.

Buffalo recently awarded a contract for the purchase of trailer equipment, and Savannah, Philadelphia and a number of other cities are experimenting with the use of trailers in garbage and ash removal. Newark, Hoboken, Jersey City and Passaic in New Jersey are investigating.

Method of Operation—Briefly, the method of operation with trailers is as follows: Single trailers, drawn by teams and accompanied by one driver and one helper each, are assigned to designated zones in the city, where they make collections, from house to house. From 1½ to 2½ hr. is required to collect a full load of 4 to 5 cu.yd. The trailers are then driven to a central point in each zone, where they meet a motor truck drawing three or four empty trailers. These are disconnected and the truck couples up to a train of three or four loaded trailers, the operation taking 10 to 15 min. The teams are hitched to the empty trailers and proceed with collection, while the trucks haul the loaded trains to the municipal incinerator plant, as in Memphis, to the city dump, as in Bridgeport, or to a pig farm outside the city, as in Utica.

Thus the highest efficiency is attained, as the trucks are used for long hauls with loads of 12 to 20 cu.yd. at a speed of 8 to 10 mi. an hour, and the horses are used for the slower work of collecting and the shorter daily mileage. All waiting time of the truck, with its relatively high fixed and operating charges, is avoided. Rehandling of the material is also avoided by use of the trailers for both collection and disposal. Fixed and operating charges for the trailers are but a fraction of those for the trucks, so that their use in collection work is little, if any, more expensive than collection with wagons. The higher interest on investment as compared with wagons is offset by the greater ease and speed of loading, due to the 5-ft. level of the body sides and to their greater load capacity.

The following is a record of results obtained in Utica with this system: In eight months, from April to

November, 1919, collections were increased from three a month under the old horse and wagon system to two a week; complaints of non-collection received decreased from 1,350 under the old system to 158 for the corresponding period in 1918; length of haul increased from 1.6 to 4 mi.; tons of garbage collected increased from 5,000 to 6,283; and average cost per ton-mile decreased from $2.36 under the old system to $1.26 under the new. In the eight months the trucks covered 11,000 mi., or a little more than 50 mi. a day. The route to the pig farm was over an unimproved country road, with grades of 7 to 8 per cent in places, but little trouble has been experienced at any time in pulling the trains of loaded trailers.

Hoboken's Refuse Disposal Problem—Hoboken, N. J., is trying to find the best solution to its refuse disposal problem and is investigating various methods. At present the work is done under the contract plan with twelve 2-horse, 2-yd., bottom-dump wagons. The dumps are on vacant lots in the center of the city. These city dumps can no longer be tolerated, as the city permits

MULES HAUL TRAILERS FOR HOUSE COLLECTION OF GARBAGE AT MEMPHIS
Loaded trailers are made up into trains and hauled to incinerator by motor truck.

indiscriminate mixing of garbage, ashes and papers and the refuse piles are offensive, particularly in hot weather.

The authorities have considered disposal by trolley, by railroad, by barges towed from the waterfront out to sea, by incinerator plant and by truck and trailer. The last-named method seems to be most feasible and economical. An incinerator plant would cost many thousands of dollars to build and would be objectionable, not only to the citizens of Hoboken but to adjoining communities. Removal by trolley would require establishment of a city loading place, with sidetracks and ramps for wagons or trucks. All dockage space on the waterfront is owned or under lease by private interests, thus preventing use of the barge plan. The city is hedged in on the north and south by Weehawken and Jersey City, and on the west by the high Palisades, crowned with the town of Union Hill. The nearest available dumping ground is the Hackensack meadows, at Secaucus, a haul of 3 or 4 mi. Hoboken has a population of about 70,000 concentrated in an area of 1¼ sq.mi. It has about 48 mi. of streets and collections are made six days in the week. The maximum amount of material to be hauled per day is 480 cu.yd.

If the twelve horse-drawn wagons now in use haul this amount of material daily it means an average of 40 yd. each—twenty trips with 2-yd. loads to the dump in the center of the city. If trailers are substituted they should haul an equal yardage to the center of the city, but the 6- or 8-mi. round trip to the Secaucus dump would consume an hour. It is, therefore, likely that

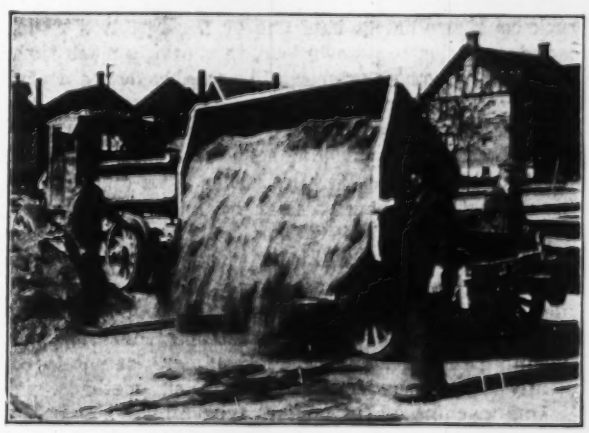
UNLOADING AT MEMPHIS INCINERATOR

an equipment of fifteen to twenty trailers and three to five tractors would be needed. This would involve an expenditure of $50,000 to $75,000.

State Law an Obstacle—One difficulty that stands in the way of adoption of the trailer system at present is a provision in the state motor-vehicle laws of New Jersey which prohibits the towing of more than one trailer by a motor truck or tractor. The Commissioner of Motor Vehicles holds that he has no authority under the law to make an exception of equipment owned and operated by cities. Cost of garbage and ash collection with horses and wagons has increased to such an extent, however, and the necessity of disposing of refuse at considerable distances outside of incorporated cities is so urgent that it is probable pressure will be brought on the state legislature to amend the law so as to permit two or three trailers to be operated in a train.

Trailers on Winnipeg Road Work—An interesting example of municipal use of trailers in road construction work is furnished by Winnipeg, Canada. The Greater Winnipeg Water District, which supplies water to the city and surrounding communities, has developed gravel pits along the aqueduct for city road building. The material is brought into the city by rail and discharged into bins, erected by the water district. From these bins it is distributed to the road jobs by six 3½-ton trucks and six 4-ton trailers equipped with steel side-dump bodies. The gravel trailers, however, do not have drop frames, as loading does not have to be done over the sides by men, but is by gravity from chutes.

The average round-trip haul is 8 mi., mostly over



TRUCK AND 4-TON SIDE-DUMP TRAILER FOR ROAD REPAIR AT WINNIPEG

COMBINATION STREET FLUSHER AND SPRINKLER

paved streets. During last August all of the trucks and trailers operated an average of 18 hr. a day every day in the month. The total yardage hauled was 11,700, or an average of 450 yd. a day, half of which was carried on the trucks. A record of operating costs shows an average of 17½ cents per cubic yard per mile. With reference to the performance of the equipment the Greater Winnipeg Water Commission says:

"The trucks when hauling trailers make about 75 per cent as many trips as they make without trailers. This is due to loss of time in turning around on streets that are torn up for paving. Otherwise there would be no loss of time. Gas consumption is about the same. Six yards are hauled per trip with truck and trailer and only three yards per trip when trailer is not used."

Street Repair Work—City street departments and county highway commissions use trailers of various types for street and highway construction and maintenance. The four-wheel, dump-body type is most used for repair work. The end-dump body is perhaps most common, as it is convenient for dumping and spreading material on spots to be resurfaced. Where counties have much new road construction and operate their own equipment the work can be done most economically with trains of slow-speed bottom-dump trailers drawn by tractors. Half a dozen such trailers, carrying 25 to 30 tons, are often hauled by the tractor on each trip.

Snow Removal—City-owned trailers operated by the public-works or street departments are used for various other purposes than ash and garbage removal. Frequently they haul coal or other supplies for hospitals, schools and other public buildings, bridge materials or snow. Snow removal work offers a field of great utility. During storms motor trucks are needed for plowing the snow and their time is largely wasted in hauling the snow away to be dumped. As the snow is light one truck could ordinarily haul one or perhaps two trailer loads in addition to its own load, thus saving much time.

Eventually some engineer will probably devise a plan whereby motor snow plows will raise the snow from the street as they proceed and deposit it directly into trailers towed behind or hauled alongside by another truck, thereby avoiding leaving piles at the sides or center of the street to be shoveled later by hand into wagons, trucks or trailers. This will not only save the expense of hand shoveling but will leave the street entirely clear for traffic immediately after the plows have passed. Piles of snow will not be allowed to stand and freeze over night, often causing great traffic confusion and remaining sometimes for a week or more, as not infrequently happens under present inefficient methods.

[One machine of the general type referred to in the foregoing paragraph was described in *Engineering News-Record* Jan. 27, p. 176.—EDITOR.]

Wood-Block Paving in St. Louis

BY JOHN STANLEY CRANDELL
Consulting Engineer, General Tarvia Department, The Barrett Co., New York City

THE present specifications for wood-block pavements of the American Wood Preservers Association are the result of fifteen years' experience in the industry covering all parts of the country. They represent the best practice for average conditions. When some extraordinary condition arises modifications may be in order, but the utmost care must be used and the best expert opinion obtained before any substitutes are tried.

Two important papers appeared during 1920 in *Engineering News-Record*, Apr. 22, p. 714, and Oct. 7, p. 686, by W. W. Horner, chief engineer, Sewers and Paving, St. Louis, Mo., describing in detail the trouble that has been experienced in that city with wood-block pavements and how these troubles have been overcome. The troubles have been somewhat unusual, while the methods used to overcome them were unique and ingenious. The deductions that may be drawn from his two papers, and from the address of Dr. Hermann von Schrenk, given at the A. S. M. I. convention held in St. Louis, are apt to be misleading, and, if acted on without taking into account all the circumstances, might result in serious mistakes.

METHODS OF TREATMENT

The latest article by Mr. Horner makes it appear that green lumber, cut into blocks, treated with creosote oil and laid, will inevitably shrink, and that therefore only thoroughly seasoned lumber should be used. Dr. von Schrenk argued for seasoned lumber, and showed pictures of green lumber in which the sapwood had decayed. He said that green blocks might not get good penetration, and therefore might rot, so that this was an additional argument for the use of seasoned lumber.

From Mr. Horner's article and from Dr. von Schrenk's talk the conclusion would be drawn that the trouble with wood-block pavements is shrinkage, instead of expansion. This is contrary to the experience of the majority of those who have studied the subject.

Paving blocks are usually given a "full cell" treatment. This means that a predetermined amount of oil is forced into them. When this amount is injected, the treatment stops, irrespective of whether or not the blocks are uniformly treated. The amount of oil that has been recommended until recently has been 16 lb. per cu.ft. The tendency now is to reduce this amount to 12 to 14 lb. It must be kept in mind that Southern pine will, in paving-block form, take a treatment up to 28 lb. Well-seasoned sapwood has far less resistance to penetration of oil than heartwood. Therefore, if seasoned blocks are treated, and the pressure is discontinued when 14 lb. of oil have been forced into the wood, it is inevitable that the sapwood must absorb most of the oil, leaving the heartwood untreated. The heartwood is therefore not impregnated, and will be subject to early decay. Hence it is dangerous to specify a seasoned block, unless a change is made in the specification for treatment.

By using the "empty cell" specification, seasoned lumber may be used satisfactorily. This means that the blocks are treated with creosote oil under pressure to refusal, when a vacuum is drawn, which removes the excess oil from the cells. Yet the oil will be well

distributed through the blocks, help waterproof them and prevent decay.

It is not possible to waterproof paving blocks thoroughly with any known treatment of creosote oil. Hence, if the blocks are thoroughly seasoned, and therefore contracted, even though they get a modified treatment by the empty-cell method, they will expand in the presence of water. If, then, they are laid close together and jacked up, as shown in Mr. Horner's illustrations, and water flows over them, they will certainly swell, and eventually the pavement will blow up. This may not happen the first year, when the presence of oil may keep out some of the water, but later, when the oil has evaporated to some extent, there is sure to be trouble.

Another result of jacking up the blocks so closely is that no filler can get into the joints, but water can and will. Dr. Felix Kleeburg made some interesting experiments three years ago—which I was fortunate to see—in which he showed that with blocks laid hand tight, no attempt being made to force them together, pitch filler penetrated the joints scarcely an inch, and asphalt filler much less. It was after watching his experiments that I conceived the idea of the cardboard spacer for wood-block pavements which assured the filling of the joints. (See *Engineering News-Record*, Sept. 4, 1919, p. 463.) If the filler does not prevent the entrance of water into the joints, then, with a seasoned block it may be confidently expected that blow-ups will occur, for water will find its way into the joints and will be absorbed by the blocks.

St. Louis' experience has been different from that of other cities. Minneapolis, Toledo, Cleveland, Akron, Detroit, Springfield, Mass., and Lebanon, Pa., have laid blocks under the pitch-paint-coat specifications, and in none of them has any trouble like St. Louis' developed.

Conclusions

McPherson Avenue is one of the streets referred to by Mr. Horner. The conclusions to be drawn from this job are valueless. The blocks were delivered, stacked, and laid during a protracted hot spell. The pitch-paint coat was spread ¼ in. thick over rough concrete. In fact, an attempt was made to level up the irregularities of the concrete by spreading the pitch thicker over the very rough spots. The extreme heat prevented the pitch-paint coat from hardening. The blocks were laid in the soft pitch, often with wide joints, some of them being ⅜ in. wide. These wide joints were filled with pitch, and an excess was used, so that it flowed under the blocks. Then more pitch was put into the joints when they were empty. As a result the pitch ran to the gutters where it collected in lakes and had to be removed.

This job emphasized the necessity for securing an even surface on the concrete base, the application of a very thin pitch-paint coat which should not be used to equalize irregularities in the surface of the concrete, and the use of a pitch-sand mastic to fill up any such irregularities if they could not otherwise be prevented. It also indicates that the present specifications should be modified to the extent of calling for a high melting point pitch in Southern cities where the paving work is done during the summer. It would be well to specify a melting point of 175 deg. F.

The extremely effective waterproofing qualities of the pitch-paint coat method of construction may, in some cases, necessitate a modification of treatment. But it would not be wise to throw away the experience of years and substitute new specifications for the present ones, simply because St. Louis has had such a peculiar experience, due solely to certain local conditions that would obtain nowhere else.

[The foregoing comments by Mr. Crandell were submitted to Mr. Horner, whose reply follows.—Editor.]

I have read with much interest the letter of Mr. Crandell concerning recent articles on wood-block paving by myself and Dr. von Schrenk. As noted by Mr. Crandell, both Dr. von Schrenk and I arrived at the conclusion that seasoned lumber should be used for wood-block paving. Our conclusions came from different viewpoints, however, Dr. von Schrenk being interested primarily in the treatment of the wood, while my interest was in the method of laying.

General Considerations

I think we will all agree with Mr. Crandell that the treatment of over-dry timber will undoubtedly result in poor treatment of the heartwood. I should like very much to see wood block treated by the empty-cell specification, and hope that we may eventually come to this if the increased cost is not too considerable. In the question of laying, however, Mr. Crandell has apparently misunderstood my impressions. I agree with him that creosote oil does not waterproof paving block. My point is, however, that our paving methods, in which the blocks are laid on pitch and surrounded by pitch, or by asphalt, do waterproof the block on five of its six sides. The upper side, which is the roadway surface, is more or less sealed by the brooming effect of traffic, and, in any case, is not in contact with water for long periods. In fact, it has been well demonstrated that the absorption of water on the upper surface of wood block has never been serious, and most of our blow-ups have been occasioned by the absorption of water in the sand cushion under the block. I think it is fair, therefore, to say that, with the present pitch-paint-coat specifications, our pavement—not the wood block, but the wood-block pavement—is reasonably waterproof, and that the absorption of water and consequent expansion will never be serious. In fact, I doubt that any cases of expansion can be cited in which this specification has been used. The fact that the block would shrink during dry weather has not only been proven, but is entirely logical.

Mr. Crandell's statement as to the McPherson Avenue job is in error. The conditions he describes as to the pitch-paint-coat and width of joints, apply to the pavement after shrinkage and not before. It is true that the joints in this job were not forced tight, that lug block were used, and that the lugs were not always tight against adjoining block, but I doubt that there were any original joints which greatly exceeded a quarter of an inch. On the other hand, the actual measured shrinkage of a single block was as much as three-eighths of an inch.

Mr. Crandell has raised one very good point, and that is the fact that the filler cannot be gotten into the joints after block have been jacked tight. It is unfortunately true, however, as he illustrates, that neither can the filler be gotten into the joints when they are laid in the usual way, and that some separator such as he has devised is of great advantage. Of all

the combination of laying I should like to see the block laid loosely, filled, then jacked up to take care of ultimate shrinkage.

While the writer is not an expert in paving pitches, and has the greatest respect for Mr. Crandell's opinion, he rather doubts that the recommendation for 175 deg. F. melting point pitch would be satisfactory on account of the cold winters in this climate. It might, however, be highly advisable for the south.

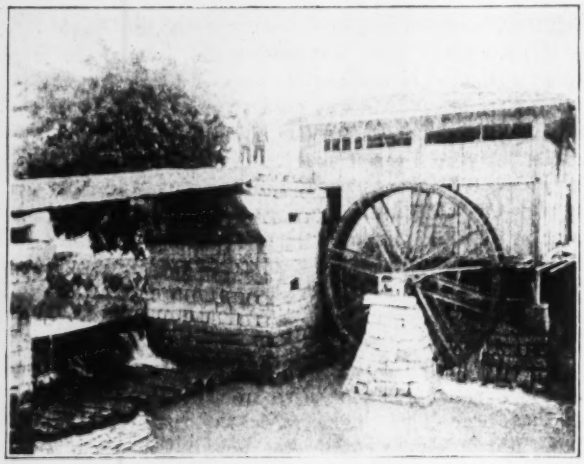
The writer has no desire to disparage our wood-block pavements, which are undoubtedly one of our finest types, and certainly will be continued to be used wherever high-class improvements are warranted. He has intended his criticism to be constructive, and has hoped that some definite suggestions for further improvement on this type of pavement might result from discussion. He is not at this time prepared to offer any changes in specifications, but would like to see a further study of the action of wood block laid under the pitch-paint-coat method in various climates, and a scientific study made of the results.

A Chinese Tidal Power Plant

By J. R. West

Engineer-in-Chief, Min River Conservancy, Foochow, China

THE Chinese have long been given credit for many inventions, such as the mariners' compass, explosive powder and the process of printing from movable type, but so far as the writer knows they have not been given credit for having utilized the energy of the tides.



IMPULSE WHEEL IN CHINA DRIVEN BY TIDAL POWER

This, however, they are doing near Foochow and probably also at many other places where the conditions are favorable. The accompanying picture shows a rice mill operated by tidal power and gives a fair idea of the general arrangement.

The plant is located on a small tidal creek which discharges during the ebb tide toward the right. When the tide starts to rise the stop logs are removed and the creek fills up to the level of high tide. The stop logs are then inserted in grooves cut in the stone piers and hold up a considerable volume of water as the tide falls. When the tide has fallen on the lower side of the dam to about the level of the lowest point of the wheel the outlet gate is opened and the water discharges through a wooden flume and impinges against the buckets in the rim of the wheel which actually operates as an impulse wheel.

The wheel itself is about 18 ft. in diameter and 2½ ft. wide. It is made entirely of wood, formed around a square hardwood shaft. The bearings for the shaft are also of hardwood and are lubricated by water which is carried in a bamboo trough from a point a little above the center of the wheel and just a little outside the rim where the drip from the rising wheel is collected by another trough parallel with the face of the wheel.

The wheel is set so that the lowest point is several feet above the level of low tide. This, of course, makes the maximum operating head less than the tidal rise, but it also makes it possible to operate the plant for several hours at every low tide. In fact this particular mill can operate five or six hours at each low tide or ten to twelve hours out of the twenty-four. The power is used for running a crude rice cleaning and polishing machine so there is little disadvantage in its intermittence.

While the amount of power developed is small, still the plant effects the application of tidal power in a useful way and the entire construction shows mechanical ingenuity and skill of high order.

Illinois Sewage Testing Station

EXPERIMENTAL work on the treatment of sewage from Champaign was started in the fall of 1920 by the State Water Survey at the University of Illinois utilizing the Dorr-Peck modification of the activated-sludge process. The plant is located west of the old septic tank built in the nineties and later used for activated-sludge tests in 1916.

The station equipment includes a Dorrco screen, two combined aërating and settling tanks of the Dorr-Peck type, a sludge-storage tank and a steam boiler. An Oliver continuous filter adapted from the mining fields and a Tolhurst centrifuge are being used for sludge-dewatering experiments. Weirs, meters and manometers for measuring the flow of air and water are provided.

The screen is 4 ft. in diameter, 8 in. wide and revolves in a trapped chamber to which the sewage flows by gravity. The flow is from the outside into the barrel of the screen, from which the effluent is discharged at one side. The screen revolves at 23 r.p.m., giving a peripheral speed of 325 ft. per minute. The metal drum consists of a punched plate with perforations ½ in. by $\frac{1}{16}$ in., the long axis perpendicular to the circumference of the screen barrel. Approximately 50 per cent of the screen barrel is submerged when treating 200,000 gal. of sewage per 24 hours. The screened solids accumulate in the trapped chamber and are scooped out once or twice a day with a perforated bucket. Loss of head through the screen is about 3 in.

The Dorr-Peck equipment consists of two round wooden tanks, each 17 ft. in diameter by 13 ft. deep. The settling tray in the second tank is 1 ft. lower than that in the first tank. Each tank contains 36 filtros plates. The mechanism for moving sludge revolves once in 9 minutes. With a flow of 100,000 gal. per 24 hours, the aëration period in the first tank was 3.2 hours, settling 18 hours, aëration in second tank 2.8 hours, settling 2.2 hours, giving a total time of passage through both tanks of 10 hours with 6 hours' aëration. Less than 1 cu.ft. of air per gal. is required to treat Champaign sewage, which is a rather heavy domestic sewage. The experiments are being carried out under the direction of Dr. Arthur M. Buswell, chief, State Water Survey.

Early Measurements of Rainfall and Stream Flow

THAT problems which now occupy the attention of engineers are in no wise new is well illustrated by the measurements of rainfall and stream flow of the drainage basin of Seine River which were made in the 17th century by Perrault (1628-1703) and Mariotte (1620-1684), both members of the Academy of Science under Louis XIV. These measurements were made chiefly to disprove the old and very persistent assumption that the water which falls as rain and snow is entirely too insignificant in quantity to supply the volume carried by rivers, and therefore the water of springs and streams must have some mysterious internal origin.

The following extracts, describing the work of these two pioneers in quantitative hydrology, were translated by the late A. J. Ellis, geologist, U. S. Geological Survey, from a volume by L'Abbe Paramelle entitled, "L'Art de decouvrir les sources," first published in 1856:

Perrault was the first who made use of the rain gage to determine the amount of meteoric water discharged annually on the earth, and he found that the mean quantity which fell at Paris during the years 1668, 1669 and 1670 was about 19.2 inches.

* * * *

Perrault examined and measured the basin of the Seine from its source to Aignay-le-Duc, in Burgundy; this basin is about three leagues long and two wide, which gives an area of six square leagues, making 31,245,140 square toises [1 square toise = 36 square feet]. Supposing that during one year all the rain water which falls on the basin accumulates there, remaining in place and suffering no loss by evaporation or otherwise, on the last day of the year that area would be covered by a sheet of water having a thickness of 19.2 in., which would make 224,899,942 muids of water [1 muid = 8 cu.ft.]. One-sixth of this amount would be sufficient to furnish the ordinary flow of the Seine at Aignay-le-Duc during the whole year following, even though, by supposition, the basin should not receive an additional drop of water; for at that place the river has, in mean terms, a flow of about 1,200 in., which gives 99,600 muids of water in 24 hr. and 36,453,600 in a year; likewise the quantity of water contained in this basin, supposing it to be 224,899,942 muids, and the amount flowing in a year being only 36,453,600 muids, it follows that the water which passes in the channel of the Seine at Aignay-le-Duc during one year is, within a trifle, only a sixth of that which during the same time falls on its basin.

Following Perrault, Mariotte made observations and calculations to estimate the quantity of water that falls each year upon the entire drainage basin of the Seine above Paris. His work is described as follows by Paramelle:

Mariotte measured all that part of the basin of the Seine which is above Paris, and, making allowance for the numerous irregularities in its perimeter, he estimated this surface to be 60 leagues long and 50 leagues wide, which makes 3,000 square leagues. Abandoning the high quantities which the observations already made furnished him he was content to suppose that there fell on the basin 15 in. of water each year, which makes 45 cu.ft. of water per square toise. A league being 2,300 toises long, one square league contains 5,290,000 toises, which multiplied by 45 gives 238,050,000 cu.ft. of water per year, and the 3,000 leagues of surface give 714,150,000,000 cu.ft. of water per year.

Mariotte's stream-gaging methods and the use he made of the results are then described by Paramelle as follows:

In order then to determine what quantity of water passes Paris every year in the channel of the Seine and to compare it with that which falls on its basin Mariotte proved that when the water of that river is at its mean elevation it is 400 ft. wide and 5 ft. deep. By throwing into the water a body light enough to float, such as a small block of cork, dry wood, wax, etc., he found after many experiments that the body floated, and consequently the water in the river flowed at a mean rate of 100 ft. per minute, which makes 6,000 ft. per hour. Multiplying the 400 ft. width by 5 ft. depth one gets a section of flowing water of 2,000 ft., which multiplied by 100 ft., which it flows each minute, gives 200,000 cu.ft. each minute, 12,000,000 per hour, 288,000,000 per 24 hours and 105,120,000,000 per year; which is not, he concluded, a sixth part of the water which falls in one year on the lands which furnish the water of the Seine at Paris. If instead of 15 in., which were taken in this calculation, 18 had been taken, there would have been obtained for each year 856,980,000,000 cu.ft., which gives eight times more water than the river carries at Paris.

Fees for Structural Engineers in Illinois

A CODE of practice or ethics and a schedule of minimum fees for professional work have been adopted by the Structural Engineers Association of Illinois, the charges being based upon a per-diem rate, a retainer fee, a percentage of cost of work or the actual engineering cost plus a fixed fee. The schedule is given herewith, practically in full:

Per-Diem Rate—The minimum charges for professional services for consultations, studies, investigations, reports and for expert testimony and preparatory work incident to law suits, shall be as follows: (1) For short engagements, $100 per day; (2) for preliminary studies, investigations and reports made to determine whether the engineer can support the claims of the client, as for example prior to a law suit, $50 per day; (3) for submitting a report and reviewing the design prepared by others for existing or proposed work, $100 per day for the first week, $75 per day for the next week and $50 for each day thereafter.

The above charges are intended to cover professional services only, unless otherwise previously agreed. Any expense incurred in connection with a specific engagement, such as transportation and subsistence, salaries paid assistants engaged on the work, office and field supplies, and general office expense, shall be charged the client in addition to the above fees.

Retainer Fee—Where a member has been retained for general advice by a firm or corporation for a long term of engagement, he may accept such retainers at a compensation not less than that indicated above.

Percentage of Cost of Work—Minimum fees, as percentages of cost of the work, shall be charged as follows: (1) For preliminary examinations, studies and reports on new projects or for review study and reports on existing or pending projects previously dealt with by others, 3 per cent; work under this head may be charged for under the per-diem terms if preferable; (2) for investigations, plans and specifications necessary to secure an intelligent bid from contractors, 5½ per cent; (3) for final working drawings and specifications, together with necessary consultation and general advice during construction, 7½ per cent; (4) for professional services, including preparation of final plans specifications and contract forms, award of contracts, superintendence during construction, testing of materials and general supervision of work, 10 per cent; (5) for professional services incident to engagements involving repairs or alterations to existing buildings or other structures, 10 per cent.

	$100,000 to $250,000	$250,000 to $500,000	$500,000 to $1,000,000	$1,000,000 and upward
1	2½%	2%	1½%	1%
2	5%	4½%	4%	3½%
3	7%	6½%	6%	5%
4	9%	7½%	6½%	5½%
5	9%	7½%	6½%	5½%

The above percentages shall be construed as applying to work not exceeding $100,000 in cost. The minimum percentages to be applied on larger work shall be as in the foregoing table.

The percentages are to be computed upon the total cost of the completed work, exclusive of engineering, or upon a bona fide estimated cost or bid pending the completion of the work, with an adjustment when the actual cost is known. The "cost of work" refers only to such part or parts of the whole work or project for which the engineer has been engaged; clearly excepting, however, all buildings and other similar structures, for which the fee shall apply to the entire cost of the building, not including special machinery, lighting, heating, plumbing or ventilation, unless these items require special consideration by the engineer, in which event the percentages shall be applied in whole or in part to any or all of these items as circumstances may direct. The percentages include all the charges mentioned at the end of paragraph on per-diem, unless previously otherwise agreed.

Engineering Cost Plus Fixed Fee—An engagement may be accepted on this basis, which contemplates a charge to the client to cover the salaries of assistants engaged on the work, and general office expense, with an addition of 50 to 100 per cent for overhead. In addition, the charge to the client shall be increased for the professional services of the engineer, an amount equal to not less than 50 per cent of the fees indicated under "Percentage of Cost of Work."

It is recommended that members require of the client a written agreement stating clearly and fully the conditions of the engagement, the period during which the work is to be executed, the amount of remuneration to be paid the engineer and the terms of payment. Where changes in plans, specifications or contracts are required by the client after work has been commenced thereon, an additional charge may be made for such changes at actual cost plus a percentage, as indicated in the preceding paragraph.

No recommendation is made to cover this contingency, and members are urged to reach a fair and equitable agreement with the client without recourse to legal proceedings or arbitration. Where an engagement has been accepted by an engineer with the expectation of an immediate start and the work is delayed by the client, the engineer may ask for additional remuneration, if proceeding with the delayed work would entail an additional financial burden on him.

Members may enter into competitions providing that the conditions provide for a reasonable compensation to cover the cost of preparing the competitive designs, and that the conditions surrounding the competitions conform to the provisions of the code of practice relating thereto. Drawings, specifications, notes, letters, exhibits, etc., as instruments of service, are the property of the engineer, and shall be returned to him at the conclusion of any specific engagement. The cost of surveys, when required, is not included in any of the fees mentioned in this schedule and is to be paid for by the client, unless otherwise specifically agreed to by the engineer.

Lincoln Highway Completely Marked

The Lincoln Highway Association in 1920 completed the permanent marking of the road from the east coast as far west as Omaha, Neb. The work cost $30,000. The western section of the highway to the Pacific coast had been previously marked.

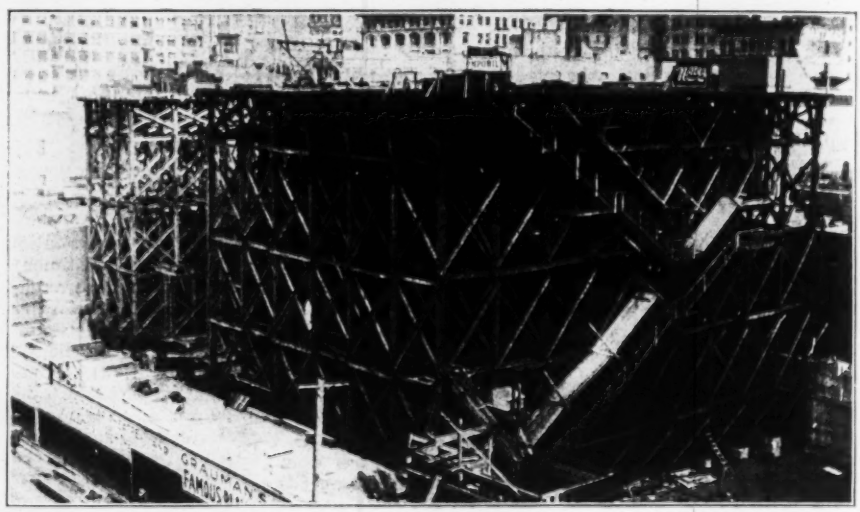
Large Timber Frame to Support Concrete Truss Forms

Los Angeles Theater Will Have 126 Ft. Proscenium Trusses for Which Heavy Platform Has Been Built

By Roy C. Mitchell
Engineer, With Edwin Bergstrom, Architect, Los Angeles, Cal.

EXCEPTIONALLY long reinforced-concrete girders and trusses are being used in the new Hill Street Building, now being erected at Sixth and Hill Sts., Los Angeles, Cal., and to carry some of them during construction there has been built a very large timber frame which is shown in the accompanying view and drawing. The details of the girders and trusses themselves will be described in a later article.

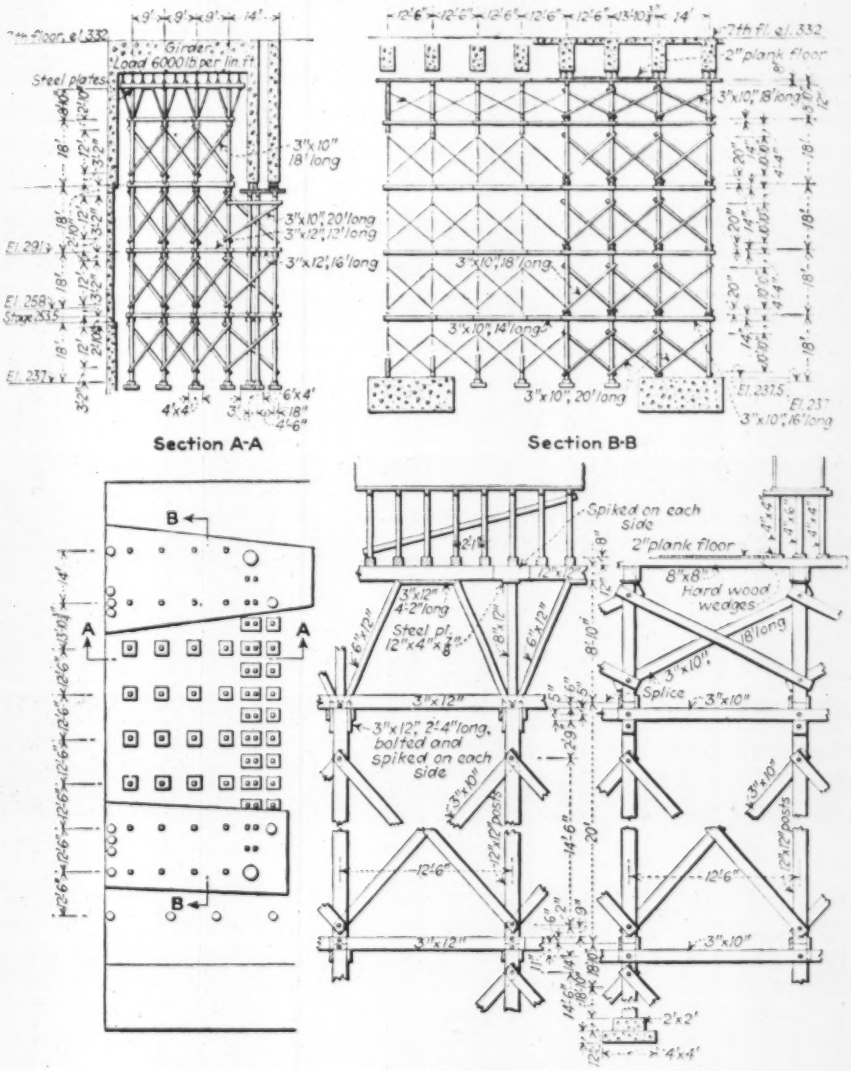
The structure, 13 stories in height with a basement and boiler room, will be for office and theatre purposes. Grauman's Metropolitan theatre will occupy the greater part of the first eight stories, the auditorium of which will be 125 x 137 ft. and the stage, 48 ft. x 127 ft. There will be stores on the first floor and above them 106 offices in the first eight stories and 355 offices in the five stories above. The upper tier of offices will be arranged in a U shape, forming an open court on the Hill Street frontage, the north wing of the U, 48 ft. deep, being over the stage and suported by the trusses over the stage, and the center wing 50 ft. deep, on the alley supported on the trusses over the theater and auditorium.



TIMBER FRAMEWORK ON WHICH 126 FT. CONCRETE TRUSSES WILL BE BUILT

The entire structure will be of reinforced concrete with brick and terra-cotta facing. The noteworthy structural features are a girder of 126 ft. 6 in. span, carrying the cantilever balcony, a truss of 87 ft. 6 in. span over the stage proscenium arch, supporting the ends of the eight girders over the stage. These in turn support the five stories of offices above. There are besides ten trusses each of 126 ft. 6 in. span carrying the auditorium roof and the five-story tier of offices above along the alley side.

The falsework required for supporting the forms and concrete for these girders and trusses is of unusual design and size. Each truss over the auditorium weighs



DETAILS OF TIMBER PLATFORM FOR HILL STREET BUILDING TRUSSES

10,000 lb. per lin. ft. and will be supported on 10 posts spaced 12 ft. 6 in. centers, requiring in all 100 posts to carry the forms for the auditorium trusses; the stage girders and proscenium truss forms require 67 posts. The falsework is 90 ft. high made up in five bents of 12 x 12 in. timbers for posts with 3 x 10's and 3 x 12's for bracing and ties, bolted together with ¾ in. bolts. The posts will set on concrete footings which will later carry the auditorium floor.

The entire top of the falsework is covered with 8 x 8 in. sleepers spaced about 2 ft. centers on which is laid a 2 in. floor. This framing will carry the forms for the trusses and girders and will make a working floor for the men. This floor will be reached by a 5-ft. covered stairway built on the side of the falsework, with landings at each floor level of the building. Hardwood wedges are to be used on top of the 8 x 8 in. sleepers for leveling up the forms and for releasing the load before removing the falsework. About 425,000 ft. B.M. lumber is required for the falsework which was received direct from the mills by boat to Los Angeles harbor, then by truck as required for erection. The framing for the falsework was all laid out from templates and the holes bored with hand electric driven bits before erecting. Erection was started at the southwest corner by erecting a bent of three columns each way for the entire height with hand A-frame. Erection was then carried forward with a small, stiff-leg derrick set on top of this bent and operated by an electric hoist in the basement. About 25 posts with bracing and ties, one tier in height, were set in one day with a crew of 12 men. Special care was taken in the design and layout so as to give the maximum salvage from the lumber when taken down, as there is a ready sale for this material for mine shoring and tunnel work.

This falsework has been laid out so that the concrete can be placed in the trusses before the columns and walls are built, as the forms and concrete for the auditorium floor and balcony will have to be placed after this falsework has been taken down. A saving in time of about 90 days will be made by having this falsework in place, ready for the general contractor to begin work on the forms for the trusses immediately after the contract is let.

Bins for the storage of rock, sand and cement have been built in the basement along Hill Street side. Trucks drive directly off the street on a platform and dump their loads in the bins beneath. There will be two mixing plants; each will be supplied with material by a system of belt conveyors, elevators and mixing hoppers without handling.

The falsework was erected by the Winter Construction Co. The falsework, bins and conveyor system was designed by the writer in the office of Edwin Bergstrom, the architect.

Colorado Free Employment Bureau for Engineers

For the ten months ending Dec. 31, 1920, the free employment bureau of the Colorado Society of Engineers listed 214 positions and filled 148. Of the latter 95 were civil engineering places, 31 mechanical, 13 mining, 2 electrical, 3 chemical and 4 miscellaneous. Of the 321 non-member applications 222 were from civil engineers. The average salary of positions filled was $170 and the average cost of placing each applicant $5. The estimated saving to the engineers of Colorado was $14,000 over the usual fee charge.

Thoroughfare Plan and Program for Cleveland, Ohio

Includes Widening 98 Streets 190 Miles and Extending 37 Streets 23 Miles, Besides Under- and Over-Crossings, Bridges and Speedway—Estimated Cost of 20-Year Program $20,000,000, Excluding Bridges

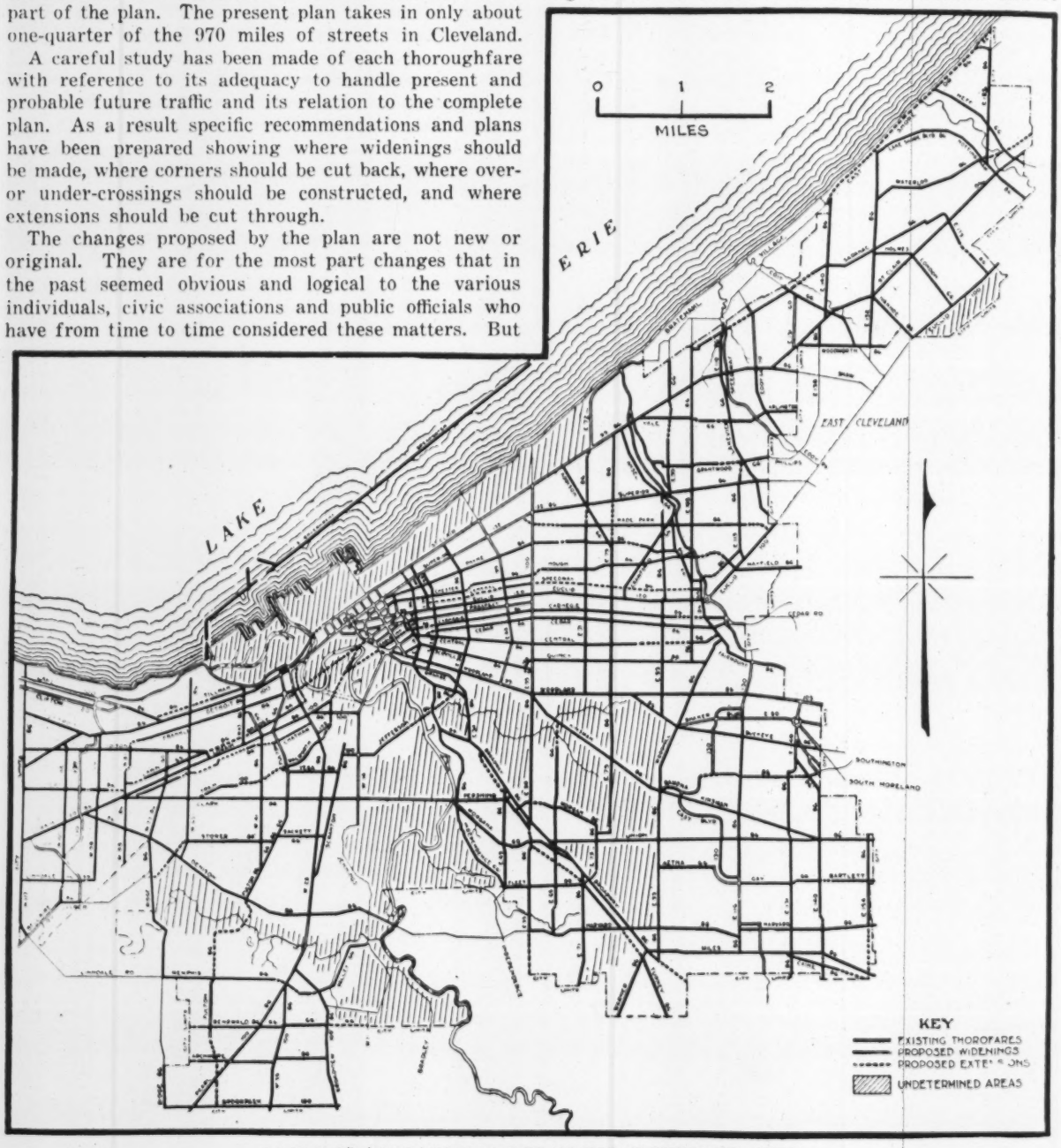
By Robert H. Whitten
Advisor, City Plan Commission, Cleveland, Ohio

THE Cleveland thoroughfare plan is intended to constitute a fairly complete system of traffic arteries for the area within the present city limits. The term thoroughfare as here used includes all streets that form the main framework of the general street plan. The thoroughfares collect the traffic of the local streets and carry it to all parts of the city. Local streets that are used chiefly for immediate access to the residences or industries of a small area are not a part of the plan. The present plan takes in only about one-quarter of the 970 miles of streets in Cleveland.

A careful study has been made of each thoroughfare with reference to its adequacy to handle present and probable future traffic and its relation to the complete plan. As a result specific recommendations and plans have been prepared showing where widenings should be made, where corners should be cut back, where over- or under-crossings should be constructed, and where extensions should be cut through.

The changes proposed by the plan are not new or original. They are for the most part changes that in the past seemed obvious and logical to the various individuals, civic associations and public officials who have from time to time considered these matters. But now, for the first time, they are sifted, assorted and brought together as parts of a complete and carefully co-ordinated plan. Presented in this way the importance of each to the general system is at once apparent.

The plan submitted is by no means ideal. The area included is already largely built up and it seemed altogether impracticable to proceed except with constant regard to the expense involved and the danger of creating burdens in excess of the economic benefits and of



PROPOSED THOROUGHFARE PLAN FOR CLEVELAND, OHIO

the ability of the city to finance. The plan, however, will provide with reasonable adequacy for traffic needs for a considerable period of years. As compared with most other big cities, Cleveland's position as regards traffic conditions will be relatively advantageous. The plan, while far from ideal, constitutes a great improvement and its substantial achievement is well worth striving for.

Street Widening—The plan provides for the widening of 98 thoroughfares having a length in the portions proposed to be widened of 190 miles.

Existing thoroughfares have to a very large extent been opened and improved without regard to a general plan. This accounts for the frequent jogs in alignment, the lack of adequate connections and above all the entirely inadequate widths that are so general over the major portion of the city. Important traffic routes have been opened and improved apparently as purely local residence streets. Old country roads have been built up at their original widths of 66, 60, 50 or even 40 ft. Double-track car lines have been placed in 50-ft. streets with no provision for street widening.

A large part of the street railway trackage is located on streets and roadways of inadequate width. To provide reasonable freedom and speed both for street cars and for other traffic a roadway wide enough for one line of moving vehicles on either side of the car tracks, in addition to space for vehicles standing at the curbs, is absolutely essential. For this purpose a roadway width of 56 ft. is needed. This, with a sidewalk width of 15 ft., gives a total street width of 86 feet.

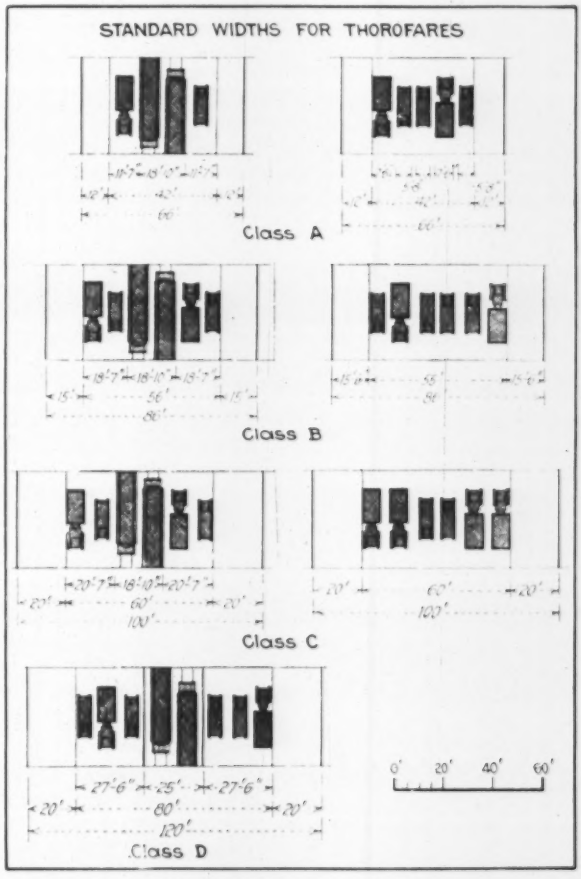
The plan submitted proposes the eventual widening to a minimum width of 86 ft. of most of the important thoroughfares and of practically all of the thoroughfares on which street railways now are or may be located. All such thoroughfares should be widened so as to provide for two lines of moving vehicles in each direction. Unless this is done, with the increase in traffic and the increase in the number of standing vehicles, the speed of all vehicles will be reduced to the speed of the slowest. Automobiles and street cars will be compelled to trail behind the slow-moving horse-drawn vehicles. A thoroughfare of that kind is very unsatisfactory for passenger automobiles, for street cars and for motor trucks.

Street Widths and Traffic Capacity

The normal development for a car-line street is retail business. Lorain Ave. is perhaps typical of the traffic and the kind of business development that will come to most of these thoroughfares. With business comes an increase in the number of vehicles standing at the curbs that makes it essential to have a clear central roadway width for two lines of moving vehicles in each direction. Unless this is done the speed of the street cars will be reduced to the speed of the slowest trucks, and automobiles will be compelled to trail behind the cars. Nothing could be more inimical to the future prosperity of the city than to permit these main arteries of traffic to be solidly built up at their present inadequate widths.

The relation between traffic congestion and street car operation is well set forth in a report to the City Council by street railway commissioner Fielder Sanders, Jan. 25, 1917:

It can easily be seen without argument that the downtown streets are saturated with traffic—street cars and vehicles. The street car traffic has been so delayed by this



STANDARD WIDTHS FOR CLEVELAND THOROUGHFARES

great excess in vehicle traffic that in order to prevent tie ups and gaps on the line it has been necessary to increase the running time on several of the lines so that the cars may remain properly spaced. This is very expensive for the car riders. The public service commission of Massachusetts stated this obvious truth in the following language:

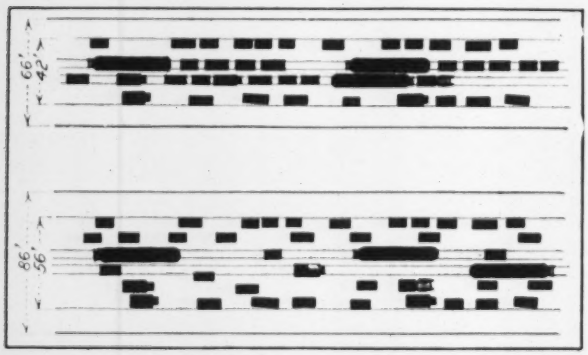
"Economy demands the largest possible car mileage in proportion to car-hours and this makes the speed at which cars are operated very important. This fact is generally recognized by street railway managers at the present time and upon well operated roads every effort is made to increase the average speed. The better the speed, also as a rule, the greater the traffic."

It has been one of the distinguishing characteristics of the Cleveland Railway Co. that it has operated its cars very fast. It has the highest schedule of surface railroads in the country and this in large measure has not only made service attractive but has made also three-cent fare possible. It is this cheapness of operation also which has so far made five-cent rapid transit tube operation financially impossible in Cleveland. This speed is now breaking down on account of being interfered with by traffic, the system is slowing up, but only to some slight degree, however, away from the congested districts.

It is only by giving attention to the widening of many thoroughfares that the present high car speed outside of the center of congestion near the public square can be long maintained. Unless this is done street cars on many important arteries will be compelled to crawl along behind slow-moving trucks. It will be impossible to keep the trucks off the tracks, because with the increase in the number of standing vehicles at the curb there will be no space in these narrow roadways other

than the tracks in which the trucks can move. This will mean increased cost of street railway operation and increased fares and loss of time to the car riders. It will also mean continual interruption to automobile traffic and increased trucking costs.

On many of the thoroughfares that are listed for eventual widening the buildings are at present set back from the street line. There is no urgent need for their immediate widening. The important thing is to insure



TRAFFIC EFFICIENCY OF 86- AND 66-FT. STREET

The 86-ft. thoroughfare takes but 30 per cent more land than the 66-ft., yet it is four times as efficient. It will pass twice the traffic at two or three times the average speed.

that future buildings, stores or apartments shall be kept back from the present street line a sufficient distance to allow for a future widening. The widenings proposed would in many cases injure the use of the houses for residence purposes by cutting off the front lawns and bringing the street too close to the houses. The use of many of these streets will, however, gradually change from private dwellings to apartments or business buildings. When this time comes the street can be physically widened without injury to such apartment or business use. In the meantime, the fixing of a permanent building line back of the present street line will serve to protect the existing dwellings from serious depreciation owing to the possible erection of an apartment house on the present narrow street line and projecting out beyond the present dwellings. And when traffic has so increased that the street must be widened, it is more than likely that the street will no longer be desirable for private residence purposes and the private dwellings will have been replaced by apartments or by business buildings. Provision for future widening through the establishment of a setback line can therefore be made while the future traffic thoroughfare is still a residence street, with advantage to all owners, and when the time comes to widen the street to meet traffic needs this too will usually be to the advantage of the owners. By thus imposing the setback line and then widening the street at the very time that these things can be done with advantage both to the owners and the city, the widened thoroughfare can be secured at a minimum expense.

Many of the thoroughfares listed for widening are already in the transition stage. The former residences are being gradually replaced by apartments and stores. Most of the stores and some of the apartments are being placed out beyond the residences on the street line. Now is the time to stop this development before the exceptional example becomes the rule. Many of the structures already built out to the line are temporary wood buildings or "taxpayers." Eventually they will be replaced and if in the meantime other buildings have been kept back on the established line the street can be widened with comparatively slight expense and a minimum delay to the usual traffic.

Street Extensions—Thirty-seven street extensions are proposed, having an aggregate length of 23 miles. These extensions will necessarily be more expensive than the widenings. Recommended extensions are therefore carefully limited to the connections deemed necessary to secure a fairly complete thoroughfare layout. In no section of the present city should thoroughfares be more than a half mile apart. Owing to existing building development, this minimum standard has not been attained in a few sections of the city. Wherever possible without too great cost existing streets have been connected by short extensions so as to form through routes. Many of these extensions, if not provided for now, will be cut through in later years at enormously increased cost.

Central Thoroughfares—The central section of the city lying between Fulton Road on the west and E. 105th St. on the east and lying north of the valleys of Walworth Run, the Cuyahoga River and Kingsbury Run will embrace the principal business and community center of the Cleveland metropolitan area. The topography of the city is such that the bulk of the traffic to, from or through this business and community center must pass in a generally east-and-west direction. This section will therefore require all the increased east-and-west traffic capacity that it is now practical to secure.

In all large cities the demand is for more routes leading into and through the central business district. In Cleveland, the traffic difficulties are in large measure due to the reliance on a few main thoroughfares converging at or near the public square. The remedy lies in the provision of more thoroughfares of adequate width coming from the outskirts of the city into and through the central business section and out to the city boundaries on the opposite side. The central business section of the city should have an approximately rectangular layout each street constituting the central portion of a main radial thoroughfare.

The street widenings and extensions proposed in this central section of the city will take care of the estimated increase in traffic for a period of thirty to fifty years.

Central Bridges—Locations for the construction of future bridges across Cuyahoga Valley are recommended as follows:

1. Old Superior Viaduct to be connected with St. Clair Ave. at W. 9th St.
2. Proposed Huron-Lorain Bridge to be constructed with a connection to Eagle Ave. at Ontario St. to meet the proposed westerly extension of Carnegie Avenue.
3. Additional high-level bridge from Huron Road and Ontario St. to Franklin Ave. to connect a great through route made up of Euclid Ave. and Huron Road on the east side and of Franklin Ave. and Madison Ave. on the west side.
4. A high-level bridge from E. 30th St. and Pittsburg Ave. to Jefferson Ave. and W. 5th St. This will provide an East Side-West Side belt-line route.

The construction of all of these bridges will be required to meet traffic demands within thirty to fifty years.

Standard Thoroughfare Widths—The following standard thoroughfare widths and cross-sections, expressed in feet, are recommended:

Class	Street	Roadway	Sidewalk
A	66	40–42	13–12
B	86	55–56	15 5-15
C	100	60	20
D	120	76–80	22 20
E	140 and over		

The 66-ft. thoroughfare is undesirable unless traffic is light, unless the number of vehicles standing at the curb is negligible, unless there are no street car tracks, and unless the traffic using the thoroughfare is predominately either of the fast or the slow type. It will seldom be wise to apply the 66-ft. standard in laying out a city thoroughfare in as yet undeveloped territory. It is, however, a standard that it will frequently be expedient to apply in replanning the thoroughfare system of a built-up area. In the plan submitted, the 66-ft. standard is applied to a considerable number of narrow thoroughfares where the existing development seemed to make it inadvisable to attempt to secure a more adequate width.

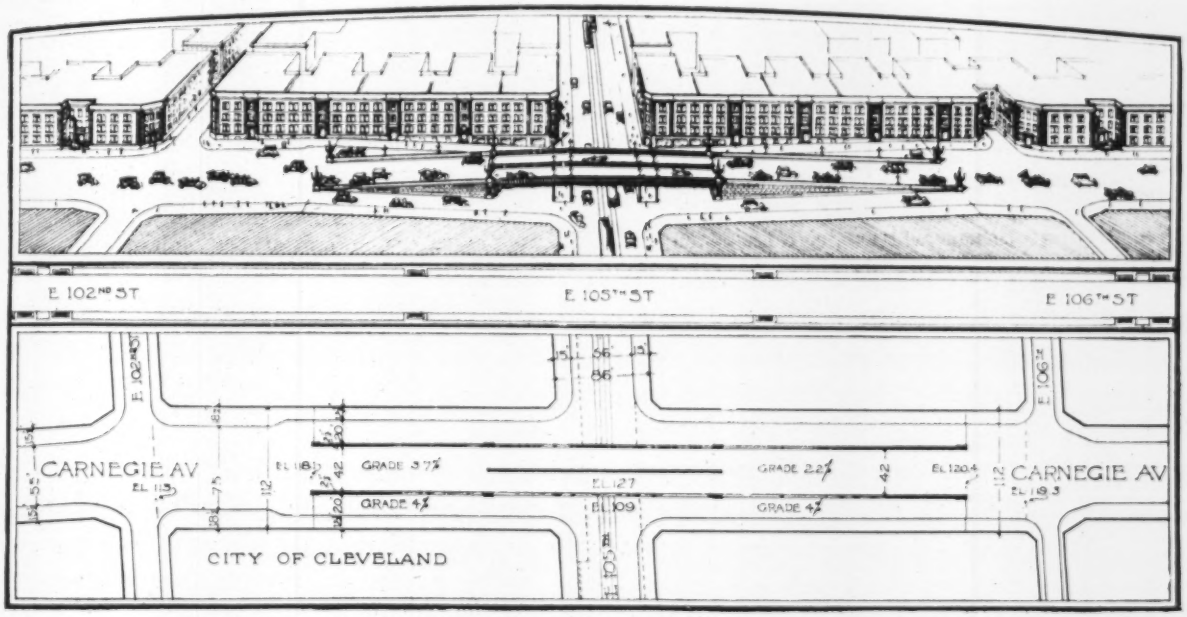
The 86-ft. thoroughfare, with a 56-ft. roadway, provides for two lines of moving vehicles in each direction in addition to space for vehicles standing at the curbs. In the plan submitted the 86-ft. standard is applied to most of the routes recommended for widening or extension. It is the minimum width that seems at all adequate for any but minor thoroughfares. It should at least be a minimum for all main thoroughfares and for most street car routes and for all routes crossing the entire length or breadth of the future central business district.

It is recommended that the traffic ordinance be amended to require a special license for any vehicle more than 7½ ft. wide.

Over- and Under-Crossings—Various methods of separating grades at street intersections have been devised and a number have been applied. Where applied, however, it has usually been to meet exceptional demands of topography or traffic and not to solve the problem of a typical busy intersection. A separation of grades is comparatively simple if provided for at the time the streets are laid out and the grades established.

In the case of the typical busy intersection a complete separation of grades is not practicable. The intersecting routes cannot be completely separated as in the case of a steam railroad and a highway. Freedom of interchange of traffic between the two intersecting streets must be retained. The most that can be done is to carry the through traffic of one of the streets over or under the intersection. The intersection itself will still be complicated by the interchange traffic of both streets and by the pedestrian traffic of both streets.

In the extension of Carnegie Ave. it is recommended



PROPOSED CARNEGIE EXTENSION OVER-CROSSING AT E. 105TH ST., CLEVELAND

that an over-crossing be constructed to carry its through traffic over E. 105th St. Over-crossings are also recommended for eventual construction in Superior Ave., both at E. 30th St., where a car line has been authorized, and at the E. 55th St. transfer point. The width of Superior Ave. (132 ft.) and the comparatively undeveloped condition of the street frontage affected greatly simplifies the construction of over-crossings in these locations.

Speedways—In city railway transportation the elevated road and subway have not superseded the street surface railway but have merely supplemented it. The evolution of vehicular traffic may be somewhat similar. As traffic is slowed down and the average length of haul increases the problem of providing a number of high-speed routes to carry traffic through the more congested areas will become urgent. Unless such routes are planned long in advance of their actual need, they will be almost prohibitively expensive when at length they are imperatively required. Cleveland's topography is favorable to the development of a number of speedways radiating from the heart of the city. The river valley and its branching ravines furnish possible locations for such routes. The lake front also may be

used for this purpose. These possibilities should be further studied in connection with plans for terminal and rapid transit development and in connection with plans for lake front improvement.

A plan is submitted for the construction of a three-mile speedway in the partially undeveloped area immediately north of Euclid Ave., between E. 21st St. and East Boulevard.

The Traffic Problem—Street traffic is increasing much more rapidly than population. If the growth of street traffic merely kept pace with the growth of population the problem of making adequate provision for the future would be sufficiently difficult. It is probable, however, that the street burden will under normal conditions increase twice as fast as population; i.e., while population is doubling the street traffic will be trebled.

The traffic problem is chiefly one of average speed and not of the number of vehicles it is physically possible to move through the streets. Even with all the interruption due to cross traffic there is abundant street capacity in so far as number of vehicles that it is possible to pass through the streets during any 2- or 12-hour period is concerned. All the traffic offering can doubtless be taken care of—the only question is with what delay and with what average speed. If an average speed of 2 to 6 miles an hour will suffice, there is no traffic problem now and possibly never will be. But if an average speed of 10 to 20 miles is demanded, the traffic problem is extremely urgent and difficult.

Extreme congestion means not only that street car service is disrupted but also that all trucking and commercial traffic is slowed down. The cost of trucking is a much larger factor in the cost of most goods than is railroad freight. Many products are transferred by vehicle through city streets a half dozen times before they reach the consumer. If through street congestion, as is undoubtedly true in parts of Chicago, New York and London, the time and cost of trucking goods is doubled, the toll due to congestion is certainly enormous. It is paid in part by the public in higher prices. It also places a serious handicap on the commerce and industry of the city.

Method of Carrying Out the Plan—The entire plan here proposed is not suggested for immediate execution but as a twenty-year improvement program. Most of the street extensions proposed should be made soon as there is no other way of preventing their being blocked by the erection of expensive buildings. The widenings, however, can for the most part be made gradually, as and when new buildings are constructed or existing buildings are reconstructed. In this way the widened thoroughfare can eventually be secured (probably by the time it is imperatively needed) and the value of the existing buildings will be saved. It is proposed that the plan shall be submitted to the city council for approval as the official thoroughfare plan of the city.

The cost of carrying out the plan is dependent on various factors not clearly ascertainable at the present time. Probably the cost will not be less than $20,000,000, not including the proposed Cuyahoga valley bridges. A financial program authorizing the expenditure of from one to two millions annually should be adopted in order that the most urgent features of the plan may be carried out and the erection of any buildings that would seriously interfere with the eventual carrying out of the plan prevented.

The Cost of Delay—Chicago is now spending more than $80,000,000 in the widening, extension and improvement of a few main thoroughfares. Most of this expense would have been saved if Chicago had prepared a thoroughfare plan when it was the size that Cleveland now is and had adhered to it ever since. Cleveland in a few years will be compelled to expend similar amounts for improvements that can now be provided for at comparatively trifling cost.

There is nothing quite so permanent and difficult to change materially as a city's streets after they have once been solidly built up with business buildings or apartment houses. Buildings have come and gone but the streets of central Boston and lower Manhattan retain most of their original crooks and turns. On many of the streets included in the proposed thoroughfare plan for eventual widening, the buildings are for the most part set back from the street line. Now is the time to provide either for the immediate widening of these thoroughfares, or for their eventual widening—say, when new buildings are constructed or the present residences are replaced by stores and apartment houses. Cleveland is building up and spreading out so rapidly that every year's delay in the adoption and enforcement of a thoroughfare plan will mean an enormous loss to the future city both in money outlay and in commercial and industrial efficiency.

The plan outlined in this article has received the tentative approval of the City Plan Commission and is now being presented to the public for its study and criticism. The plan has been prepared by Robert H. Whitten and Frank R. Walker, the advisors of the commission, in close co-operation with Robert Hoffman, city engineer. C. E. Conley, engineer of the commission, has had immediate supervision of the work and has contributed largely to the plan as now presented.

Extent of Irrigated Area in California

During the past two years, 25 new irrigation districts have been organized in California and one has been dissolved, making a present net total of 68 districts, according to the seventh biennial report of the state department of engineering. The area of these districts ranges from 192 to 603,840 acres, with a total of 3,008,000 acres under district organization. Of the 1,535,000 acres on which there is bonded indebtedness, the amount varies from $3.48 to $106.45 per acre and aggregates $39,900,000; an average of $26 per acre. During the last two years the bond issues approved totaled $14,788,000. Of the area in the state incorporated in irrigation districts, slightly over 2,000,000 acres is in the great central valley of California, i.e., the Sacramento and San Joaquin basins. In the Sacra- 350,000 Valley the irrigation districts comprise abou 350,000 acres and in the San Joaquin Calley about 1,712,000 acres. The sources of water supply in this central valley and in the Pit River basin are as follows:

	Acres
Area supplied by pumping from streams	227,619
Area supplied by natural flow, gravity canals	766,126
Area supplied by stream flow with storage	1,171,124
Area supplied from underground sources alone	55,578
Total	2,219,847

Most of the 68 districts are now in operation; several have not yet completed their work, while a few have not been able to acquire the necessary water or begin construction.

Incomes in Engineering Profession Compared with Others

Iowa Engineering Society Investigation of Net Income of Doctors, Lawyers and Dentists Indicates Engineers Low

DO PRESENT fees and salaries enable the engineer and his employees to maintain a scale of living fair in comparison with that of other professions? The answer to this question was sought by a committee on compensation of the Iowa Engineering Society during the past year. The results obtained from sending out 1,500 inquiries, with 35 per cent replied to, were presented to the recent annual meeting by L. A. Canfield, secretary.

The committee does not favor the establishment of maximum salaries but believes that an engineer, if he

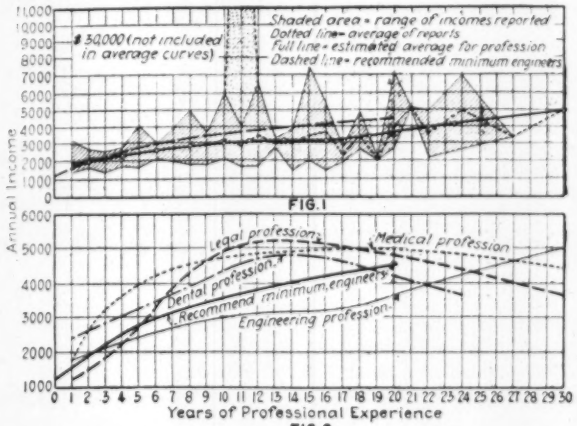


FIG. 1

FIG. 2

COMPARISON OF AVERAGE INCOMES OF THREE PROFESSIONS COMPARED WITH ENGINEERS

is at all worthy of the profession, should not be forced to drop below a minimum net income which will enable him to advance and to maintain a respectable standard as a professional man.

As to fees charged it was the opinion of the committee that little can be done until services rendered have been defined or standardized. It held something should be done in this direction since minimum fees charged by practicing engineers materially govern the net incomes of men in private practice and their employees.

Fig. 1 gives the net income of engineers from all branches of the profession according to the years of experience. The latter were considered equal to years spent in college. The points governing the location of the estimated average were obtained by averaging the reports for several years together and plotting at the center of the range of years considered. Near the high end of the curve as many as six years' reports were averaged together on the assumption that men of several years' experience could easily be six years apart in their attainments. This number was gradually reduced to a minimum of three years at the low end of the curve. This method of averaging has practically the same effect as increasing the number of reports and, in fact, gave the same values as the exact average of reports near the lower end of the curve where a sufficient number of reports were received to give a smooth curve. The recommended minimum was obtained by plotting the values given in the table. Similarly curves were drawn for the other professions. In Fig. 2, which shows the comparison of all the professions, engineers seem finally to surpasse all three professions after the first quarter century.

BASIS FOR RECOMMENDED MINIMUM NET INCOME

Years of experience	0	3	5	7	10	20
No. in family	1	2	3	4	5	5
Food:						
Groc., meat, ice	.....	$30 50	$36 25	$43 50	$51 00	$56 00
Milk	.....	4 50	6 25	9 00	9 00	9 00
Meals out	30 00	5 00	7 50	7 50	10 00	20 00
Total	$30 00	$40 00	$50 00	$60 00	$70 00	$85 00
Clothing:						
Man	$15 00	$12 50	$12 50	$12 50	$15 00	$18 00
Woman	.....	12 50	15 00	15 00	17 50	20 00
Children	.....	.....	5 00	8 00	10 00	25 00
Laundry	5 00	2 00	6 00	6 00	7 50	10 00
Total	$20 00	$27 00	$38 50	$41 50	$50 00	$73 00
House maintenance:						
Rent	$12 00	$40 00	$45 00	$50 00	$60 00	$65 00
Furniture	.....	12 00	12 00	12 00	10 00	10 00
Phone	.....	.....	2 50	2 50	2 50	3 00
Fuel, light, water	.....	12 00	13 00	14 00	14 00	16 00
Total	$12 00	$64 00	$72 50	$78 50	$86 50	$94 00
Personal:						
Health	$2 50	$5 00	$10 00	$10 00	$10 00	$8 00
Recreation	7 00	8 00	6 00	6 0	8 00	20 00
Books	1 00	1 50	1 50	1 50	2 50	5 00
Magazines, papers	2 50	3 00	3 00	3 00	3 00	4 00
Travel	2 00	4 00	4 00	5 00	5 00	10 00
Clubs, societies	2 50	3 00	4 00	6 00	8 00	10 00
Church gifts	5 00	5 00	5 00	6 50	9 00	14 00
Tech. books, etc.	2 00	2 00	2 00	3 00	4 00	4 00
Life insurance	7 00	10 00	15 00	17 50	20 00	15 00
Taxes	1 50	1 50	2 50	4 00	5 00	8 00
Incidentals	10 00	13 50	16 00	17 50	19 00	25 00
Total	$43 00	$54 00	$69 00	$80 00	$93 50	$123 00
Monthly total	$105 00	$187 50	$230 00	$260 00	$300 00	$375 00
Yearly total	$1,260 00	$2,250 00	$2,760 00	$3,120 00	$3,600 00	$4,500 00

The basis of the minimum suggested is shown in the table in which the committee attempted to take into consideration the following facts: An engineer must be assured the necessities of life; and in order to progress and maintain even a humble station as a professional man he must be allowed certain other things such as memberships in engineering societies, the purchase of books and magazines and a reasonable amount of recreation. This table is not intended to be an exact minimum for engineers in all localities but is intended to be a reasonable minimum under the prevailing costs during the year 1920 in the State of Iowa, for the conditions assumed as to number of years of experience and the number in a family. The assumptions as to experience and number in a family are believed to be about the average conditions and due allowance should be made when these assumptions do not apply. The table does not provide for any savings account or unusual expense.

Timber Combination Highway Bridges

Combination truss bridges with timber top chords and posts and steel bottom chords and diagonals have been used extensively for highways in Montana, but the State Highway Commission now recommends them only for secondary roads. Where timber is to be used the Howe type of truss, with both chords of timber, is considered preferable. The principal reason for this preference is that in the combination truss, the timber top chord does not function properly with the steel bottom chord, so that it is difficult to retain the camber after a year or two of service. No Howe truss bridges have been built by the Commission and it is not likely that any standard designs will be made for such structures, as a recent ruling of the U. S. Bureau of Public Roads would eliminate consideration of timber bridges on Federal-aid road projects.

Cost-Plus Contract Gives Low Cost on Ashland Filters

By L. R. Howson
Principal Assistant Engineer, Alvord & Burdick, Chicago, Ill.

By adopting a cost-plus sliding-fee contract for intakes, a dry well and a coagulating basin at Ashland, Ky., the city saved nearly $20,000, compared with the lowest bid on a unit-price contract; the contractor made a fee of 10 per cent, with no hazard other than a possible reduction in fee, and both parties to the contract are well satisfied.

Early in 1919 plans for filtration works were prepared. The work was divided into several contracts, including one for intakes and structures. This contract covered two intakes into the Ohio River, a concrete tunnel 120 ft. long from the well to the river bank, a coagulating basin, clear well and filter house.

Bids were first received in July, 1919. Only one bid on the intake and structures contract was received and that was informal. The amount of the bid was $144,000.

The work was readvertised and an effort made to interest contractors who specialize in that class of work. When bids were opened but two proposals were received —for $125,000 and $113,000, respectively. As the funds available for this part of the entire construction were insufficient for either bid they were again rejected. After careful consideration, it was determined to omit the filter house and clear well in the belief that the available funds would be sufficient to carry out the work on that plan, and that later it would be possible to finance the construction of the part omitted.

When bids were received on the smaller amount of work it was found that the totals were but little reduced, being from $90,000 to $106,000, and all being much higher than the engineer's estimate. The small reduction in the prices bid, for the work omitted, clearly indicated that the contractors considered the construction hazard in the intakes, tunnel, and dry well as being great, and that it would be impossible to secure better bids on the fixed-price basis. This fact was pointed out to the Board of Water Commissioners of the City of Ashland. It was explained that in the engineer's opinion the bid of $90,000 included too much for contingencies; that the city should itself assume the hazard, pay for it if it existed, and profit if it did not. The board authorized the engineer and the low bidder to draw up and submit a contract on a "cost-plus-fee" basis.

A working contract was developed including the following principal articles: (1) Cost, including all labor, small tools, repairs to equipment, etc., was estimated at $65,000. The contractor was allowed a fixed sum of $2,000 for the use of major tools and equipment; (2) based upon actual cost agreeing with estimated cost, the contractor's fee should be $6,750; (3) any saving in cost below $65,000 would be shared equally by city and contractor, and (4) if actual cost exceeded $65,000 the first $1,500 excess was to be paid by the contractor; above $1,500 the contractor was to pay 20 per cent and the city 80 per cent until the fee was reduced to $3,000, after which there should be no further reduction.

The construction work was executed under this contract at practically the estimated "cost," although the Ohio River, due to the abnormally heavy rains of the fall of 1919, flooded out the work ten times. Based on the average, not more than two or three floods would have been expected. These floods caused an added cost of several thousand dollars, which would have been shared by the city and contractor under normal water stage conditions.

The Ashland contract was executed by the Joseph E. Nelson & Sons of Chicago and Kansas City. Alvord & Burdick were engineers for the city of Ashland, being represented by Roy H. Davis, as resident engineer. The writer prepared the contract under which the work was performed.

Power Commission Favors Potomac Project

Recommends That Great Falls Power and Water Supply Be Developed In Accordance with Tyler Report

In a special communication to Congress, the Federal Power Commission urges the prompt development of the water power at Great Falls on the Potomac, and the immediate prosecution of a separate project looking to the increase of the water supply for the City of Washington. In its recommendation to Congress, the commission says in part:

The Federal Power Commission is of opinion that the question of supplementary water-supply for the District of Columbia should be separated from that of power production, both for the reason that an immediate addition to the water-supply of the District of Columbia is imperatively demanded and also for the reason that the separation of the two projects involves no substantial loss of either time or money if the Congress should determine to carry out both suggestions.

For the reasons given by Major M. C. Tyler, who made the report for the Federal Power Commission, the commission is clear that the Potomac rather than the Patuxent water-supply should be developed and it earnestly recommends to the Congress the urgency of the need of the district that this project be at once undertaken.

The plan for the development of hydro-electric power from the Potomac has these great advantages: (1) It contemplates a serial development of which the several elements can be separately and consecutively undertaken, with the result that the power resources of the district will be augmented from time to time as the capacity of the district for the absorption of the power developed increases; (2) the suggested conservation of use of existing steam installation for the production of power make it highly improbable that any substantial loss will accrue to those who have invested in steam power plants, and (3) the serial development of water power will render unnecessary extensive and costly additional steam power plant installations, which would be necessary unless existing power producing facilities are supplemented as here suggested by the early development of a large body of primary power from a dam erected near Chain Bridge.

The Federal Power Commission recommends to the Congress that it authorize an immediate start in the development of power in accordance with the Tyler report. Our study of the situation satisfies us that all the power so developed will find a ready market in the District of Columbia and the circumjacent territory to which it can be transmitted without disproportionate line loss or transmission system cost.

The complete development of the Potomac with dams located at Chain Bridge and Great Falls and with the great water reservoirs for storage will constitute a national asset of incalculable value. It will save coal, labor and transportation. It will free the national capital from de-

pendence upon steam power production which is increasingly costly, and is subject to much greater likelihood of interruption at critical times due to shortage of coal. It will produce an immense body of primary and secondary power of increasing value and may well aid materially in the development of a power district about the great commercial and industrial cities from Philadelphia to Richmond, in which a steady and uniform supply will stabilize and encourage further industrial development. The project when completed will stand as an illustration to the country generally of the immense value of water-power development in the conservation of our national resources. For these reasons the Federal Power Commission concurs in the reports transmitted.

Comparison of Small House Costs for 1914, 1920 and 1921

ACCORDING to figures compiled by the Philadelphia Operative Builders Association and explained at the recent conference of all elements in the building industry called by the Industrial Relations Committee of the Chamber of Commerce, a two-story six-room dwelling, which in 1914, in that city, cost $2,969.30 to build, during 1920 cost $8,346.26, and, according to the wage schedules and material rates existing, would cost $6,676.04. The figures are based upon an operation of 100 houses. The figures included herewith were presented in chart form to show where the excessive costs still lie and to indicate savings that could be accomplished through reduction in the cost of various items.

Land upon which the house is constructed cost in 1914 $500 and in 1920 $600, and would cost $600 this year. That is considered a conservative estimate and is the cost of a lot with a 20-ft. frontage and a 40-ft. depth. The comparative street improvement costs are as follows:

	1914	1920	1921
1—Sewer	$22.50	$60.00	$60.00
2—Water pipe	15.00	30.00	30.00
3—Curb (plain)	6.00	16.50	16.50
4—Cartway paving	25.00	90.57	90.57
Total	$68.50	$197.07	$197.07

In comparing the general conditions, it was found that the greatest increase in any item was that concerning the placing of the first and second mortgages. In 1914 it cost $20 to place a first mortgage and $23 to place a second mortgage. In 1920 these costs had risen to $220 and $278 respectively and had decreased again to $108 and $128 respectively in 1921. Taxes and interest were also high and the conference decided to attack these costs with a view to securing a material reduction. The comparison of the items included under general conditions is as follows:

	1914	1920	1921
1—Plans	$1.00	$2.00	$2.00
2—Survey	3.50	5.00	5.00
3—Building permits and affidavits	5.00	7.50	7.50
4—Water permit (brick and stone)	1.80	1.80	1.80
5—Electric service			
6—Gas service		4.00	4.00
7—Fire insurance on building material	.10	.10	.10
8—Fire insurance on buildings	1.60	3.87	2.88
9—Plant and tools	5.00	15.00	12.00
10—Sales expense	64.00	176.00	144.00
11—Advertising	32.00	88.00	72.00
12—Office expense	29.40	78.60	65.50
13—Compensation insurance		7.93	6.80
14—Taxes	11.25	85.00	77.45
15—Interest	101.25	263.00	219.40
16—Title company's charges	69.75	150.25	123.75
17—Deed—acknowledging, revenue and recording	4.00	8.50	8.00
18—Expense of placing first mortgage	20.00	220.00	108.00
19—Expense of placing second mortgage	23.00	278.00	128.00
20—Supervision	18.00	36.00	36.00
21—Supplies	5.00	15.00	12.00
Total	$395.65	$1,445.55	$1,036.18

In the actual construction work 1920 costs showed an increase over 1914 costs of 204 per cent. In 1921 this figure had decreased until the construction cost was 126 per cent above the 1914 level. The comparison of the actual construction costs in the three years is:

	1914	1920	1921
1—Excavation	$40.95	$99.45	$93.60
2—Stone masonry	145.54	408.70	354.42
3—Brick masonry	226.25	703.67	659.71
4—Rough carpentry	255.42	955.41	555.67
5—Finish carpentry	266.00	850.00	610.00
6—Plastering	104.61	385.04	269.42
7—Cement work	83.00	258.54	198.76
8—Cut stone	7.70	16.00	16.00
9—Structural steel	11.80	48.47	33.63
10—Roofing and spouting	50.00	120.00	110.00
11—Plumbing and gas fitting	167.00	545.00	448.00
12—Heating	166.00	440.00	368.00
13—Electric wiring	30.00	81.25	65.00
14—Stairwork	37.50	166.00	125.00
15—Labor, general	25.00	50.00	50.00
16—Tile work	5.50	12.03	9.90
17—Iron fence and clothes poles	17.00	30.00	29.00
18—Sheet metal work	35.00	105.00	88.00
19—Cabinet work	22.70	56.00	40.00
20—Hardware—finish	11.00	35.00	32.00
21—Hardware—rough	11.00	33.00	24.00
22—Painting and glazing	100.00	225.00	215.00
23—Art glass	8.75	15.00	15.00
24—Range and connection	21.50	65.00	65.00
25—Gas water heater and connection	12.00	35.00	26.00
26—Parquetry floor	48.60	143.75	129.60
27—Flue lining and crocks	2.10	8.85	8.85
28—Grading, general	3.15	6.65	6.30
29—Paperhanging and decorating	42.75	110.00	106.88
30—Lighting fixtures	44.25	90.00	83.00
31—Sodding and seeding	2.43	4.86	4.05
32—Numbering houses	.65	1.00	1.00
Total	$2,005.15	$6,103.64	$4,842.79

Adding the totals for ground, street improvements, general conditions and construction, the cost of a two-story six-room house which in 1914 sold for $3,200 was $2,969.30. In 1920 this cost had increased to $8,346.26 and the house would be sold for $8,800. The 1921 house, costing $6,676.04, would be sold for $7,200. In 1914 a first-mortgage value on the $3,200 house was $2,000, the second-mortgage value being $700. These respective values were in 1920, $4,400 and $2,500, and in 1921, $3,600 and $2,000.

The rates of labor paid in these operations are set forth in the accompanying table. For 1914, the rates were the prevailing rates, though non-union. In 1920 and 1921 they are the actual union rates in effect. The cost of labor and that of materials are given, per hour and per unit, respectively, in the following tables:

COST OF LABOR

	1914 Per Hour	1920 Per Hour	1921 Per Hour
Common labor	$0.17½	$0.50	$0.40
Carpenters	.40	1.12½	1.00
Carpenters' helpers	.20	.60	.50
Plasterers	.50	1.25	1.25
Plasterers' helpers	.35	1.10	1.00
Bricklayers	.50	1.30	1.30
Bricklayers' helpers	.35	1.00	1.00
Stone masons	.45	1.30	1.30
Painters	.40	1.00	1.00
Roofers	.40	1.10	1.10
Roofers' helpers	.25	.70	.85
Cement finishers	.50	1.00	1.00
Cement laborers	.20	.60	.60
Tile setters	.65	1.00	1.00
Tile setters' helpers	.40	.80	.68¾
Plumbers	.44	1.15	1.15
Plumbers' helpers	.20	.75	.75
Steam fitters	.36	1.10	1.10
Steam fitters' helpers	.24	.75	.75

COST OF MATERIALS

Material	Unit	1914	1920	1921
Foundation stone	Perch	$1.40	$4.00	$3.00
Bricks	M.	7.00	20.00	18.00
Cement	Bbl.	1.55	5.25	4.50
Rough lumber	M.ft.b.m.	20.00	70.00	46.00
Flooring	M.ft.b.m.	30.00	80.00	60.00
No. 1 spruce lath, 4 ft.	M.	5.00	20.00	9.50
Builder's lime	Bu.	.25	.70	.64
Calcine plaster	Bbl.	2.00	6.25	6.25
Sand	Ton	1.30	2.95	2.80
Fibre	Bu.	.25	.35	.35
Structural steel	Cwt.	1.40	5.75	4.00
Tin	Box	8.20	22.00	22.50
Felt	Ton	30.00	110.00	85.00
Pitch	Cwt.	.70	2.00	2.10
Nails	Keg base	3.00	7.50	4.75
Sash cord	Hank	.55	1.25	.85
Tile floors	Sq.ft.	.30	1.00	.82½

The comparison in the amount paid to the subcontractors is indicated in the last table. The year 1914 was taken as a base, and the actual amount of money paid out to each sub-contractor for a specific job used as 100. Compared to that base were the 1920 and 1921 amounts.

COSTS OF SUB-CONTRACTS

	1914	1920	1921
Hardware (finish)	100	318	290
Plumbing	100	326	268
Heating	100	265	222
Painting	100	225	215
Paperhanging	100	257	250
Parquet floors	100	295	267
Roofing	100	240	220
Sheet metal work	100	300	250
Electric wiring	100	270	217
Millwork	100	315	221
Plastering	100	368	258
Gas ranges	100	300	300
Excavations	100	243	228
Rough stone foundation walls	100	308	270
Face stone work	100	226	190

The costs reproduced herein were gathered mainly by Daniel Crawford, Jr., president of the Philadelphia Operative Builders Association, who agreed to build without profit 100 such houses for laborers who could finance the actual construction.

Timber Floor Rapidly Destroyed By Dry Rot

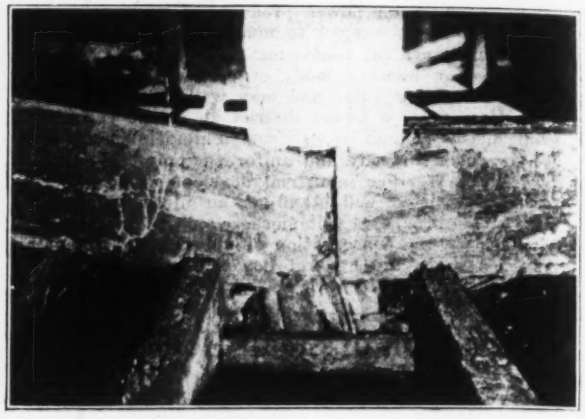
By Wilson Fitch Smith
Engineer, Merchant Shipbuilding Corporation, Harriman, Pa.

A REMARKABLE example of the rapid and complete destruction of timber by dry rot is the floor of the restaurant building of the Merchant Shipbuilding Corporation, agent for United States Shipping Board, Emergency Fleet Corporation at Harriman, Pa.

The shipyard and adjacent housing development were built during the fall and winter of 1917-18 under the unusual conditions that prevailed during that war period. (See *Engineering News Record*, Jan. 3, 1918, p. 17.) One of the last buildings erected was a one-story frame stucco restaurant with seating capacity for 2,600 people. The plans called for a concrete floor throughout the building, but in order to reduce the cost of the building just before construction was commenced it was decided to substitute a timber floor in the large cafeteria section covering an area 95 x 187 ft. The natural ground surface under this section was a dry sandy loam from 3 to 8 ft. below floor grade.

The original plans showed concrete piers spaced 15 ft. 6 in. c. to c. in both directions, to elevation of the floor level. These supported the columns, which carried the roof. The floor was 4 in. of concrete laid on a compacted fill. The plans were revised to omit the fill and show the tops of the concrete piers 2 ft. 2 in. below the finished floor grade, carrying 9 x 12-in. y.p. floor girders made up of three 3 x 12-in. pieces spiked together. These girders carried 3 x 12-in. y.p., or hemlock floor beams spaced 18 in. c. to c. on which was laid ⅞-in. rough pine flooring, a layer of building paper and ¾ x 2-in. tongue-and-groove maple flooring. Owing to the scarcity of lumber the most readily available was used and it is probable that much of it was not seasoned properly. In order to support the roof columns which had been designed to foot on the top of the concrete piers at the finished floor level 10 x 10-in. y.p. blocks 14 in. long were placed on the girders over each pier, with grain vertical, and the cast-iron column shoes were spiked to these blocks.

The construction was started in April, 1918, and the building completed by August, 1918. In the haste of the war period the change in type of flooring was made on the plans but no change was made in the drawings for the foundation walls. These were concrete, 10 in. thick to the sill level and were continuous around the entire area. Although all of the other buildings with timber floors built at this time were provided with proper ventilation windows in the foundation walls, this precaution was overlooked by the construction force who followed the plans exactly and apparently no one realized the necessity of providing ventilation. As a result the space beneath the floor was air-tight.



TIMBER FLOOR DESTROYED BY DRY ROT

In the winter of 1920, or about 18 months after the completion of the building, the floor began to sag between columns, then the columns began to settle irregularly. The deterioration was so rapid that in March, 1920, the section was closed and an investigation made. This investigation revealed that practically the whole area was infected with the fungus growth that induces dry rot. Many of the girders had become so weakened that they had broken in mid-summer. The yellow pine column footings had crushed into the ends of the girders and in many cases had themselves disintegrated so that the columns had settled 10 in. or more. The rough flooring was practically gone and the under side of the maple flooring, to a depth of half its thickness, was decayed so that the integrity of the floor was preserved solely by the upper fibers of the maple flooring.

There was hardly any of the exposed timber that was not affected but generally the greatest destruction was in the center, away from the exterior walls. The soil was comparatively dry and no moisture visible anywhere. In many places the mycellium of the fungi spread out in a thick network over the ground sometimes extending several feet beyond the scrap of wood in which it was rooted. It is apparent that the timber was infected at the time it was erected, but proper ventilation would certainly have arrested its development.

It is probable that those concerned with the design of the buildings had knowledge of the phenomenon of dry rot as ample provisions for ventilation had been made in all of the other buildings of similar nature, and the failure to provide suitable ventilation was evidently due to the haste of construction under war necessity.

This is a striking example of the costly failure that may result from the hasty modification of a plan, even though it be in the interest of economy, unless the consequences are carefully followed through to the end.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Exchange of Silver Coin at German Border—A Protest

Sir—We acknowledge receipt of copy of *Engineering News-Record* of Nov. 4, 1920. The article which concerns us contains so many erroneous statements that we take the liberty to correct them as follows:

The export of silver money is prohibited by law. Travelers passing the border are therefore obliged to produce the silver money they possess. At our exchange department in the station all foreign money is exchanged as well as silver coin. The traveler can either deposit his silver coin there or exchange it. We want to call attention to the fact that foreign silver money is not calculated at its exchange value for notes, but at the world market price for silver.

The official announcements of these quotations by the Reichsbank are shown to every traveler who wishes to see them. At the time in question the price amounted to 8 marks for one silver gulden.

You were therefore not compelled to exchange your silver money but could have deposited it or sent it to somebody known to you in Germany. If you received silver money in Berlin at the paper money rate, we, on the other hand, are not obliged to change your silver into paper money and accept the loss ourselves.

On the strength of these facts we must object energetically to your accusation of the robbery of travelers and suggest that you get into communication with the bank in question in Berlin to straighten the matter out. As far as your further serious accusation of a collusion between the bank employees and the revenue officers is concerned, we have presented this matter to the proper authorities.

Although our experience has shown us that everything which can discredit Germany is being published broadcast and in distorted fashion by our former enemies, we express the hope that your paper will assume an objective standpoint and also publish the other side's views.

Bentheim, Germany. BARMER BANK-VEREIN,
Dec. 13, 1920. HINSBERG, FISCHER & Co.

[The statements referred to were made in an article by the editor written from abroad. He stated that he had received only 20 marks at the German border city of Bentheim for a 2½ gulden piece (Dutch) for which he had paid 37½ marks the day before in Berlin. He characterized the procedure as robbery.

The intimation in the rejoinder is that the real cause of the loss was the selling bank in Berlin, that it charged for Dutch silver at the rate for Dutch notes, which presumably is at some point between the silver and the gold rates. If that were the case—and we have not the data at hand to verify or deny the point—it is obvious that on a later exchange the seller would lose. He would get merely the silver price.

Of this, though, we are certain: whether the selling banks in the interior or the buying bank at Bentheim is at fault, the effect on the traveler is the same—he leaves Germany smarting under what he considers an injustice. The editor stated that his case was not isolated, that other travelers made the same complaint. The situation is unfortunate for Germany, for this system is sending people out of the country with the feeling that they have been unfairly treated.—EDITOR.]

Cross Sectioning and Good Judgment

Sir—In your issue, Dec. 30, 1920, p. 1272, appears an interesting article on railroad cross-sections taken with the Beaman Stadia Arc.

The Western District, Interstate Commerce Commission, on grading measurements, experimented with several types of cross-section instruments, but found nothing superior to the hand-level, rod and metallic tape, with occasional use of the small Reed slope board, which gives the graphical solution of a right triangle when the slope distance is measured. In wide yards a dumpy replaced the hand-level.

In this connection it must be born in mind that in measuring grading the object is not to take a cross-section with superfine accuracy, but to determine as nearly as possible the volume of earth lying between that section and the preceding one. If too much attention is paid to niceties of instrumental work the engineer has not the opportunity of judging the natural ground slopes and properly placing the section to arrive at the correct volume closely. The purpose is to fit a number of prisms to a somewhat irregular body of earth in order to compute the cubic yardage.

To arrive at a fair figure on old grading work it may be necessary to estimate to some extent the original toe of slope which might be covered by silted ground or eroded.

For these reasons a hand-level gives best results.

Extreme accuracy of cross-sections is not as important as good judgment in selecting the point at which the section should be taken, and estimating the original surface of the ground, and no set rule for placing the sections at uniform distances apart can be adhered to. A. A. ROYCE.

Bocas del Toro, Republic of Panama, Jan. 15.

No Need to Curtail Iowa Road Work

Sir—In your issue of Jan. 6, p. 41, there is a letter by John Wilkes making a plea for higher automobile taxes, and also for the temporary curtailment of road improvements. In this article I find the name of the state of Iowa coupled with the fact that this State has the largest number of automobiles in proportion to the population; also that the people in this State borrowed the largest amount from the Federal Reserve Bank in this district in proportion to its quota of the usual crop-moving loans. In the same paragraph is mentioned the fact that South Dakota, which also ranks high in the number of automobiles in proportion to the population, is having a great many bank failures. These statements, while perhaps true, sound without a word of explanation rather derogatory to Iowa.

To begin with Iowa, being an agricultural state, and one of the best in the Union, wealth is more generally distributed among the population than in states containing large manufacturing centers. Iowa has prospered immensely the last three or four years, due to large yields and high prices. The increase in the automobiles owned in this State in that time has been enormous. Referring to the large amount of money which the people of Iowa have borrowed this year during the crop-moving season, this is traceable to a falling produce market and one of the biggest crops in years. The produce instead of going to market as is usual this time of the year is being held for better prices. This necessitates bigger loans for meeting current needs.

Iowa greatly increased its income from license fees a year ago when a law taking effect Jan. 1, 1920, based the fee collected on the cost of the car and its weight. One per cent on the cost of the car and 40c. per hundred weight is collected, the idea being that the heavier car does the most damage to the road surface. This makes the lowly "jitney" pay only $10 while a car costing $7,000 and weighing 5,000 lb. pays $90 a year for the use of the public highways if registered in Iowa.

Iowa now has a very efficient highway department under whose supervision this money along with other current funds and federal-aid funds available are being spent. In such a case there is no unusual burden being placed on the people. Iowa is going ahead steadily, spending these funds and pulling itself out of the mud. There is no occasion here for any great curtailment of road expenditures such as

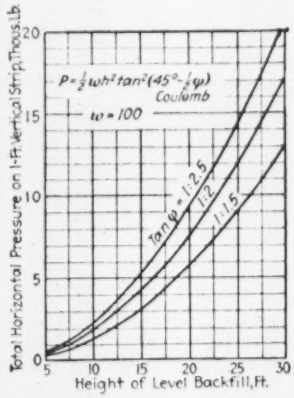
might be desirable were funds obtained solely from bond issues being sold under the present adverse financial conditions. Absolute curtailment of all road expenditures would tend further to upset present conditions.

A. P. MUNSEN,
Bridge and Paving Contractor.

Marion, Ia., Jan. 10.

Earth-Pressure Curves by Coulomb's Formula

Sir—The curves shown herewith were made up by the writer in order to have done once and for all the computation for earth pressure on retaining walls. A statement of Baker's may be recalled, that no matter how carefully earth pressure may be figured some very broad assumptions must be made to start with, so that you might almost as well assume the thickness of the wall. Coulomb's formula, however, even though it may be incorrect, gives very reliable results on a subject that is so uncertain. To simplify its application the curves were plotted only for the standard angles of repose 1 on 1½, 1 on 2, and 1 on 2½. This is as close as most of us know the slopes of materials used in construction, and, as a general rule, it is not known what material will go into a backfill until after the wall is designed and built. In such cases the curve representing a 1 on 2 angle of repose is safer than the lower one. This middle curve also agrees very closely with tests on sand, as published in *Engineering News-Record* several months ago, in which the lateral pressure was found to be 42 per cent of the vertical pressure at all depths. For the curves shown here the weight of earth is taken at 100 lb. per cu.ft., and may be easily corrected for other values. In computing the overturning moment the total pressure is to be applied at one-third the distance up from the base.



EARTH PRESSURE AGAINST RETAINING WALLS

Mason City, Iowa. A. W. BEDELL.

The Special Library Link

Sir—The New York *Times* of Sunday, Jan. 9, 1921, in its Editorial Section has a very interesting article on "Engineers Join in Research Work" with a sub-head "Agencies Co-operate in Effort to Salvage Knowledge Gained in War." While the aim of this article is to make known the co-operation of the several large engineering societies of this country in linking together their members into a vast potential force for the solution of the various problems confronting the manufacturer and scientist, it has left out a very important link in this chain of research. I refer to the library link.

We all know that today as never before scientists and manufacturers are depending more and more upon records of others as found in the printed word. Witness the growth of the service of the United Engineering Society, the generous response to the Chemists Club for increased funds, the expansion of the Technology room of the New York Public Library and, most important of all, the tremendous increase in special libraries organized since 1917 to aid large and small industries in the solutions of their problems.

With the linking up of this vast reservoir of salvaged knowledge gained from the war together with knowledge that has been made available throughout past years what greater ally to industrial research could be found?

To go back to March 20, 1915, p. 351, the *Engineering Record* published an article the text of which was: "There are today in this country a large group of engineering libraries of great value *collectively* but not suitably co-ordinated." This article finishes by saying that: "To do this work would necessarily require considerable expenditure but it would be time and money well spent."

It is not altogether unlikely that the following circumstance will be repeated many times and to avoid it we should make a national effort to harness it. I refer to a happening in an industrial city where a large manufacturing concern had been experimenting on a special process, resulting finally in failure. One of the men working on this process was talking with the librarian of the city about it. A smile crept over the librarian's face as he told the man that "that very experiment had been tried out before and found a failure. We have a record of that failure right here in one of our books." So because this concern went ahead blindly they lost some thousands of dollars and were no further ahead.

So it goes and so it will continue to go—wasting thousands of dollars annually simply by failing first to find out whether or not the proposed process, operation, or whatever it may be has ever been done before and if so what is the best way.

There are two ways that this "library link" can aid materially: (1) By published weekly an index of abstracts of articles in current technical papers. (2) By founding a large central catalog of all technical books, pamphlets, trade catalogs, and translations carefully analyzed for every item of value in them. Such a catalog would be a large undertaking but by no means impracticable. A long start has been made in the Library of the United Engineering Societies, in the Library of Congress and John Crerar Library of Chicago. This proposed library has its prototype in the International Institute of Bibliography at Brussels, which fortunately escaped the ruthlessness of the Germans and recently filed its 12 millionth card.

Additional co-operation could be gained by linking up the several hundred special libraries devoted to special industries by making them sponsors for picking out all items of pertinent value in their collections and sending copies of cards indexing these items to the proposed central catalog.

New York City, Jan. 11. K. C. WALKER.

Hydrated Lime Test Specimen Very Lean Mix

Sir—I have noted in your issue of Jan. 20, 1921, p. 121, a tabulation, giving the results of the third inspection of the specimens of concrete exposed to the action of seawater at the Boston Navy Yard. We are, of course, especially interested in the report of the action of specimen No. 22, which was the one containing hydrated line, but we feel that, as presented, the data will be misleading to the great majority of your readers who have not followed the subject closely or who have forgotten about the former reports as to the specifications and fabrication of this specimen.

The proposed specifications for these tests first appeared in *Engineering News* (Dec. 24, 1908, p. 730) in which it was proposed to use 90 per cent of average cement, made from a mixture of several cements, and 10 per cent of hydrated lime to 3 parts of sand and 6 parts of coarse aggregate. The description of the fabrication of these specimens appeared in *The Engineering Record* (Aug. 19, 1911, p. 230) from which description we find that for specimen No. 22 a mixture of nine parts of average portland cement to one part of hydrated lime was used, with 3 parts of fine bank sand from South Acton, Mass., and 6 parts of crushed trap rock, from Malden, Mass. From the same article, we find that the sand weighed 97.18 lb. per cu.ft. with 34.2 per cent voids, and that the stone weighed 90.24 lb. per cu.ft. with 50 per cent voids. The consistency was reported as being quaky with slight tamping. We further note that the specimen was cracked in handling and suspending, though no details were given as to where the crack was. This was the only specimen reported as having been injured in handling.

Throughout the reports, this specimen has always been alluded to as being of 1:3:6 mixture with 10 per cent of

hydrated lime added; as a matter of record, the hydrated lime was substituted for portland cement to the extent of 10 per cent, so that this was the leanest mixture of the entire series, the actual mixture being 1:3.33:6.66. Besides being the leanest mixture we find that, as previously noted, it was broken prior to suspension in the water.

Under date of Dec. 22, 1909, we find a report that the interior of the 3-in. cored hole was absolutely dry after the specimen had been suspended (cracked) for about ten months. This is of especial interest, in view of the facts that the specimen was the leanest mix of the entire series and that a simple calculation will show that the voids could not be completely filled, theoretically, by the cement and matrix, respectively.

Several other specimens were prepared with true 1:3:6 mixes and in 1920 we find that No. 9, 11 and 13 are in very bad condition, 15 and 17 fairly solid, No. 19 "missing," No. 7 and No. 22 entirely gone in mid section and remaining concrete rotten.

Taking into consideration the facts that hydrated lime was substituted for portland cement in specimen No. 22 and as a consequence this specimen represented the leanest mixture of the entire series, and further that the specimen was cracked in placing, it is not as much a cause for wonder that the specimen disintegrated as it did, as it is of astonishment that this specimen showed a record which compares so well with specimens made of a richer mix, and that it took over ten years for the mid-section to be entirely disintegrated. The writer would have predicted this disintegration to have been completed in three years at the outside, since calculating from the voids, as given, this specimen must have been very porous and so have allowed entire permeation of the mass by the sea water.

TYRRELL B. SHERTZER,
Construction Engineer, Eastern Bureau of National Lime Association.

New York, Feb. 2.

Stresses in Reinforced-Concrete Chimneys

Sir—Mr. Fleming's interesting article on "A Few Lapses in Textbooks" in *Engineering News-Record*, Jan. 20, 1921, p. 125, puts the writer in mind of a disagreement between two textbooks as to the stresses in a reinforced-concrete chimney when eccentrically loaded.

Hool & Johnson's "Concrete Engineer's Handbook" on p. 407 describes a graphical method as given by W. S. Wolfe, instructor in Architectural Engineering, University of Illinois, in *Engineering & Contracting*, April 25, and May 23, 1917. Under the conditions given the maximum stress in the concrete is found to be 479 lb. per sq.in. and the maximum stress in the steel is 10,650 lb. per sq.in.

Turneaure & Maurer's "Principles of Reinforced-Concrete Construction," third edition, gives a diagram, Fig. 5 on p. 419, from which the maximum stresses in the concrete and steel due to an eccentric load caused by wind pressure (the vertical component of the wind and dead load being the same in amount and location as that in Mr. Wolfe's illustration) are found to be 517 and 8,760 lb. per sq.in., respectively, as nearly as can be read from the diagram.

These results do not agree very well and in very large chimneys the difference in the stresses as found by the two methods are apt to be much greater. A case recently came to the writer's attention of a chimney about 20 ft. in diameter at the base and about 200 ft. high in which Wolfe's method gave nearly twice as much stress in the concrete and several thousand pounds per square inch more in the steel than Turneaure & Maurer's. In the latter case Taylor & Thompson's method agreed fairly well with Turneaure & Maurer's results.

In Turneaure & Maurer's method the assumption is made that the steel reinforcement is in the form of a cylindrical shell located in the center of the concrete shell and in this respect deviates somewhat from the facts.

As far as the writer can see Mr. Wolfe's method is practically accurate and yet, in the case of the large chimney before mentioned, it is difficult to account for the results obtained. In that case the line of the resultant pressure came close to the edge of the kern, indicating compression over the entire shell, but the diagram based on Wolfe's method showed much higher tensile stresses in some of the steel bars than would seem possible under the circumstances. The man who made the diagram stoutly defended its accuracy and the variation in results of the different methods was the cause of considerable discussion.

The writer would be much gratified if someone who has the courage, time and mathematical talent would analyze the different methods and determine which should be considered the standard one to use. FRANK S. BAILEY.

Boston, Mass., Feb. 17.

A Thrust Boring Machine

Sir—Your issue of Oct. 14, 1920, contains on p. 772 an article on a thrust boring machine. A somewhat similar, but cruder machine was designed by the writer about the year 1898 to push pipes through three earth dams, the object being to replace 4-in. siphon pipes by 4-in. gravitation pipes without intrefering with the water level of the reservoir.

The method was to put a concrete block against the puddle wall, the concrete block having a hole through it that would allow of the free passage of 4-in. screw pipes such as those used for lining bore holes. A pointed iron head fixed onto the end of the leading pipe was then pushed through the hole in the concrete block, other pipes being added and pushed on until the pipe emerged into the water. When everything was ready the piercing head had to be removed and the flexible joint carrying the floating intake pipe put on by divers. The object of the concrete block was to prevent any creep of water along the pipe through the puddle. W. H. SHIELDS,

Perth, Western Australia. Consulting Engineer.

Nov. 23, 1920.

An Old Water Turbine

Sir — In the onward march of science it is sometimes worthwhile to pause and review the work of our predecessors. Occasionally we receive a shock when we discover that some of the principles which we believe to be of recent origin were in reality employed years ago.

In the accompanying photograph, taken a few years ago, is shown an old water turbine. It occupies its original position, but the former mill with its equipment is entirely gone and the dam seen in the distance is in the last stages of decay. The developed head was apparently about 8 ft.

The turbine was set on the bed of the river and the unique thing about it is the discharge of the water upward and outward, with no draft tube. The runner buckets remind one of the Francis runner in principle. There were evidences of a 6 ft. power flume. A cast-iron gate is shown, admitting the water to a plate spiral casing. The turbine shaft with coupling on top clearly indicates that the turbine rests in its original position.

The plate visible on the gate casing bears an inscription somewhat as follows: "Geo. H. Jones Little Giant Turbine, Mfg. by J. C. Wilson & Co., Pictou, Ont., 1870." The power site is at Paquetteville, Province of Quebec, Canada, on a stream tributary to Hall Stream, in turn tributary to the Connecticut River. D. M. WOOD,

Boston, Feb. 21. Engineer with Stone & Webster, Inc.

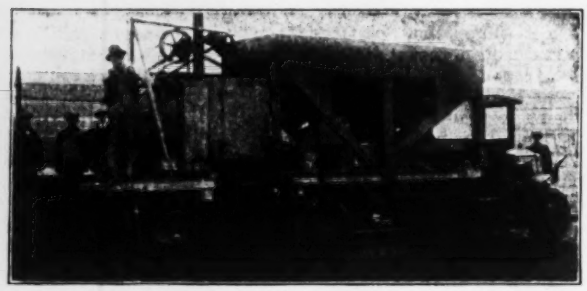
Almost a Sacred Occupation

Appreciation of the value of a potable water supply was indicated recently in a paper before the Indiana Sanitary and Water Supply Association by H. O. Garman, chief engineer, Indiana Public Service Commission, in the following terse terms: Few committees appreciate that it is but one step from the home to the cemetery and that your place in a home or in the cemetery is absolutely in the hands of some obscure, unknown, underpaid and too often unappreciated employee of the purification department of our water utilities. The management and operation of a water utility is almost a sacred occupation.

HINTS FOR THE CONTRACTOR

Mixing Plant Mounted on a Motor Truck

A MIXING plant mounted on a 6½-ton motor truck, as illustrated in the accompanying view, has been used successfully for small concreting jobs by C. S. Edwards, contracting engineer of Jersey City, N. J.



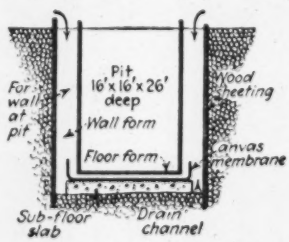
TRUCK MOUNTED MIXING PLANT FOR SMALL JOBS

The ½-cu.yd. mixer, with an elevating loading skip and a chute discharge is mounted on the rear of the truck and the remainder of the space is occupied by the stone and sand bins and the water tank. Space under the bins provides for the storage of twenty-five bags of cement. The stone bin is of 4½ cu.yd. capacity the sand bin 2½ cu.yd., and the water tank 280 gal. Briefly, about enough material for a 5 cu.yd. of concrete is carried, which is sufficient for a majority of small jobs.

Watertight Concreting in Wet Gravel

PITS and conveyor tunnels in water-bearing gravel at the Samson Tractor Co., Janesville, Wis., necessitated special methods in securing watertight concrete construction, a canvas membrane being embedded in the concrete for part of the work. Ashpits adjacent to the smokestack at the heating plant or power house constituted the most difficult problem, the largest pit being about 16 ft. square and 26 ft. deep below grade and the other 15 ft. deep.

After the general basement excavation had been taken out with a steam shovel and teams the pits were started, using tight wood sheeting all round. At first the bracing was framed and assembled in advance and driven down with the sheeting, but later the ordinary practice was adopted of driving the sheeting and then placing wales and braces as the pit was excavated. The former method was satisfactory but was found to have no advantage over the ordinary method. Sheeting was driven by hand and by a type of small air hammer on which the operator stands while driving. No jetting was used in this coarse water-bearing gravel. Pumping was done continuously by three 6- to 8-in. steam vacuum pumps and two 6-in. centrifugal pumps, one steam and one electric.



CONCRETE FLOOR OF PIT POURED FROM TOP

For the concreting a 24-in. subfloor was poured first, leaving a channel all round between it and the sheeting to carry water to the sump, as shown in the drawing. In spite of this the water flowing over the floor washed out a part of the cement in places and small springs were formed in the subfloor. Wall forms were hung in position and the reinforcing steel was placed within them. Then upon the concrete subfloor was laid a waterproofing membrane of heavy duck soaked in paraffin oil, this membrane being turned up 18 in. in the middle of each wall. Reinforcing rods for the floor proper were then placed and covered with a top form 12 in. above the sub-floor. Concrete was poured continuously from the surface of the ground until the floor and the walls were completed. A 1:2:4 mix was used, made with washed gravel and having added to it 10 lb. of hydrated lime for each sack of cement. Special care was taken to have the concrete well puddled after placing in order to form a dense mass. These pits have proved thoroughly watertight.

Tunnels and pits under a large portion of the foundry are required for the numerous molding machines and conveyors. Concrete for their floors was poured first, drain tiles being laid on the sub-grade to carry the water to sumps from which it was pumped. A groove 2 x 4 in. was cast in the floor under each wall, and was filled with oakum and tar before pouring the wall concrete. This method did not prove as satisfactory as that employed for the pits described above.

The contractors for the buildings were J. P. Cullen & Son, Janesville, Wis., and the DuPont Engineering Co., Wilmington, Del. All construction work was under the supervision of Frank D. Chase, Inc., engineers, Chicago; Horace S. Baker was engineer in charge and F. M. Reynolds was superintendent of construction.

Stench Warns Underground Workers

THE SYSTEM of warning workmen by stench in tunnels or mine shafts employs a vile smelling liquid which is injected into the main compressor air line near the surface. The air current quickly vaporizes the liquid and carries the odor to every part of the work where compressed air is being used. Thus a general alarm, warning the workmen to come to the surface can be given very quickly. Five California mining companies have recently employed this means of communication with excellent results.

Two substances used for this purpose are ethylmercaptan and amylacetate. The former is reported to be preferable; it has a disagreeable skunk-like smell and less than 0.01 per cent by volume of its vapor in air will give a strong odor. It costs about $2.25 per pound. This is used in the proportion of 1¾ pints per 100,000 cu.ft. of free air. The amylacetate or artificial "banana oil" which is easier to obtain is used in the proportion of 3½ pints per 100,000 cu.ft. of free air. It does not evaporate as quickly as the other compound and as it has a rather pleasant odor is considered less suitable than a stench for warning purposes.

NEWS OF THE WEEK

New York, March 3, 1921

Object to Early Creation of Port Authority

Jersey City Protests Against Recommendations of Harbor Development Commission's Report

In a report issued Feb. 21, 1921, the Board of Commissioners of Jersey City, N. J., definitely oppose the creation at the present time of a port authority for the metropolitan port district of New York. The opposition is directed at the recommendations of the report of the New York-New Jersey Port and Harbor Development Commission made some weeks ago. The Jersey City report was prepared by the Jersey City Development Plan Board of Engineers and approved by the Board of City Commissioners.

The basis of the opposition is made on the following counts: (1) There should have been submitted to the people of New Jersey before the New Jersey Legislature was called upon to create any port authority a complete plan and report showing definite plans for development of every part of the New Jersey portion of the metropolitan district; (2) the commission's report is not a complete report, since it has been presented practically simultaneously with the introduction of the treaty bill; sufficient time has not been allowed for the general public to become thoroughly familiar with its details; (3) the Development Commission has shown a breach of faith with the Governor of New Jersey in presenting its treaty bill less than three weeks after the publication of the summarized version of its report, contrary to a promise alleged to have been made a year ago; (4) while the treaty bill leaves to subsequent legislatures the matter of adopting the comprehensive plan, it does create in the port authority a body which will in effect dominate all future plans that may be made for rail or waterfront improvements in the New Jersey part of the metropolitan district, and the subsequent development of any of the New Jersey part of the district will be subject to the approval and control of this authority; (5) the Jersey City representatives contend that the comprehensive plan of the commission comprises mainly the construction of its automatic electric system and its tributary inner and outer belts, all of which are more directly a part of New York's development and may be detrimental to New Jersey's point of interest.

The Jersey City representatives further point out that the comprehensive plan is in effect largely a West-Side Manhattan scheme and that it does not even take care of that in toto because it has no provision for other than package freight. They maintain that the commuting travel across the Hudson is not taken care of in the comprehensive plan nor is there any appreciation of the necessity for the Hudson River bridge.

Federal-Aid Bill Killed

With the defeat of an effort to attach the $100,000,000 federal-aid road bill, which was passed by the House, to the agricultural appropriation bill, the last chance to secure this additional federal-aid appropriation at this session of Congress is lost. An unsuccessful effort had been made previously to suspend the rules and attach the House bill to the post office appropriation bill. The bill passed the House, 230 to 30.

N. C. License Bill Passes

The North Carolina legislature has passed the engineers' license law prepared by and introduced at the instance of the North Carolina Assembly American Association of Engineers.

December Record in Car Loading

A new record in average car loading was attained during the month of December, 1920, according to statistics compiled by the Bureau of Railway Economics, showing that 31⅛ tons was the average loaded into each freight car during December, which was 0.7 tons more than that attained in November, when a new mark also was reached.

Experimental Tunnel for Ventilation Tests

As part of the co-operative investigations of vehicular tunnel ventilation which are being conducted by the New York and New Jersey Bridge and Tunnel Commissions and the U. S. Bureau of Mines an experimental section of tunnel 400 ft. long, equipped with ducts, is being constructed in the bureau's experimental mine at Bruceton, Pa., just outside of Pittsburgh. Tests on diffusion of exhaust gases, temperature conditions and their physiological effects will be made.

Senate Passes Rivers and Harbors Bill as House Framed It

The Senate, on Feb. 25, passed the annual rivers and harbors appropriation bill carrying $15,000,000 of new appropriations and authority for the expenditure of $47,000,000 in unexpended balances during the next fiscal year. The bill was passed by the Senate without any alteration of the measure framed by the House. The bill allows $2,850,000 more than was carried for the present year.

Conference Urges Publicity for Engineers

Problem of Educating the Public in Technical Matters Discussed at A.A.E. Meeting

Engineers, technical journal publishers and editors, college professors, magazine writers and daily newspaper men met on the common ground of educating the public at the publicity conference of the American Association of Engineers held in Chicago Feb. 25. The conference emphasized three main points: (1) Co-relation of the various avenues of publicity; (2) possible co-operation of the various agencies; and (3) details of how to go about the task.

Dr. F. H. Newell, following an exposition of the wrongs inflicted on the engineer in public service because of a lack of appreciation of his work, indicated that the engineer mostly deserved the attacks because he had not told the people what he is doing. Progress reports in terms understandable by the layman must be made continually.

R. W. Krum, engineer of materials and tests, Iowa State Highway Commission, spoke of the success of the Iowa plan whereby the small-town newspaper editor was cultivated by the local engineer, the latter being furnished news from a central bureau. W. W. De Berard, Western editor, *Engineering News-Record*, emphasized the same idea of local contact in his plan for a national bureau of publicity.

A description of a course of engineering journalism at Iowa State College by H. E. Pride, led several editors to the point of saying they proposed to work for similar courses elsewhere.

John G. D. Mack, State chief engineer, Wisconsin, indicated a number of problems, particularly of a research nature, which, if generally known, would not only benefit the public but would react to the good of the profession.

C. R. Thomas, newly-chosen head of the publicity affairs of the association, described the legitimate field of the publicity man who stands in commercial and public organization today as an ambassador of information to the public.

Harvey V. Deuell, city editor, *Chicago Tribune*, emphasized the fact that real news cannot be kept out of the newspapers. He indicated that editors were always receptive to personal calls but he advised testing news which the caller brings by its appeal to the "man in the street." Too often an engineer's writing, he held, is heavy because he

wants the bones of his structure to show, whereas the public is only interested in the outline, general appearance and interpretation.

Richard H. Waldo, manager *Hearst's Magazine*, New York City, indicated that if half the program outlined at the conference, which he stated was practical, were carried out it would be a success. But, he added, it must be adequately financed; otherwise it would only fatten some printer. Policy plus personnel will always produce publicity, because publicity is rooted in policy. He indicated clearly that voluntary effort was of value beyond comprehension if directed by a well-organized central bureau. He especially cautioned against sending out a constant stream of mediocre bulletins which only cluttered the avenues of publicity and prevented getting attention when the big story broke.

F. M. Feiker, vice-president, McGraw-Hill Co., pledged the help of the technical press. The technical journals, he said, are the media which must be used to inform the great body of engineers before they can go out and educate the public.

Ivy L. Lee, adviser in public relations to the Pennsylvania R.R. analyzed in detail the meaning and purpose of publicity.

President Signs Bill for Partial Payment of Railroads

The Winslow bill authorizing partial payments of the Government's indebtedness to the railroads was signed by the President Feb. 26, 1921, following its passage last week in the Senate over the strenuous opposition of Senator La Follette. The bill as it came from the House was not amended in any respect. It provides immediate payment to the carriers of minimum amounts due them by the Government for the guarantee period, as quickly as certified by the Interstate Commerce Commission. It is estimated that at least some $300,000,000 is now so due.

The previous ruling of the Treasury Department against making such partial payments has, according to many railroad companies, impaired their credit to such an extent that they have been unable to meet current obligations for some operating expenses.

Vote Additional $1,000,000 for Railroad Valuation

A bill has been passed by Congress and signed by the President voting an additional $1,000,000 to the credit of the Valuation Division of the Interstate Commerce Commission to carry on the physical valuation of the railroads in accordance with the valuation and transportation acts. It was stated that funds to the credit of the Valuation Division had been practically exhausted. The appropriation was put through the Senate and the House in one day, and was signed by the President on the following day.

Want Board Named to Pass on Belle Isle Bridge Plans

In a communication of the executive committee of the Detroit Engineering Society to the city council request is made that a board of engineers be appointed to pass upon plans for the Belle Isle bridge. The committee says:

"We believe that the first and foremost consideration should be to build the best bridge possible for the purpose. The city does not want a cheap or unsubstantial structure. On the other hand, if one type of design offers legitimate economies over another this matter should be decided upon by a competent, impartial board of engineers. We therefore recommend that you select an engineering committee of about five members to pass upon all plans and data which may be submitted for this bridge. We attach a list of men recognized as eminent bridge engineers:

"A. Burton Cohen, consulting engineer, New York City; H. S. Crocker, secretary American Society of Civil Engineers, New York City; B. H. Davis, consulting engineer, New York City; A. M. Felgate, consulting engineer, Cleveland, Ohio; Prof. G. A. Hool, Madison, Wis.; F. A. Howard, Erie R.R., New York City; Prof. H. S. Jacoby, Ithaca, N. Y.; H. R. Leonard, Pennsylvania R.R., Philadelphia; J. L. Miller, New York Central R.R., New York City; Prof. C. T. Morris, Columbus, Ohio; T. G. Pihlfeldt, Chicago; F. D. Richards, consulting engineer, Cleveland, Ohio; L. K. Sherman, consulting engineer, Washington, D. C.; Prof. George Swain, Cambridge, Mass.; Prof. A. N. Talbot, Urbana, Ill.; Max Toltz, consulting engineer, St. Paul, Minn."

Public Health Service To Study Pollution of Illinois River

An intensive study of the stream pollution and stream purification conditions of the Chicago Main Drainage Channel and Illinois River has been inaugurated by the U. S. Public Health Service. The work is to be done in cooperation with the Illinois State Board of Health and the Sanitary District of Chicago. The headquarters and main laboratory is at Peoria but three branch laboratories will be equipped at other points.

It is proposed to learn (1) the extent and nature of the pollution in definite terms, (2) amount of dilution provided at all points and (3) the effect of the pollution and the power of the stream to recover. To determine these points will require (1) accurate surveys of the nature and extent of polluting wastes, (2) hydrometric studies of the daily flow, (3) enough laboratories to get prompt analysis of samples at frequent intervals along the length of the stream and (4) special studies of related subjects.

The work is under the general direction of Surgeon W. H. Frost with J. K. Hoskins, associate sanitary engineer, in immediate charge.

A. R. E. A. Convention Program

Following the annual address of the president and reports of the secretary and treasurer on the first day of the annual convention of the American Railway Engineering Association, Congress Hotel, Chicago, March 15-17, the following committee reports will be received and discussed: Signals and interlocking; ballast; stresses in railroad track; electricity; track; rail; standardization, and uniform general contract forms.

Committee reports for the second day are signs, fences and crossings; ties; iron and steel structures; water service; economics of railway labor; economics of railway operation; economics of railway location; shops and locomotive terminals, and buildings.

On Thursday, the third day of the meeting, the following committee reports will be received: Masonry; roadway; wood preservation; wooden bridges and trestles; yards and terminals; rules and organizations; records and accounts; conservation of natural resources.

John F. Wallace, consulting engineer, New York City, and David Kinley, president of the University of Illinois, will be the principal speakers at the annual dinner on the second day of the meeting.

The meeting will close, as usual, with a discussion of new business and election and installation of officers.

Proposals for Store-Door Delivery Go to Railroad Executives

Following resolutions adopted by the transportation committee of the Federal Highway Council railway traffic executives in the eastern territory now have before them proposals for store-door delivery and collection of freight. A motion has been adopted that "the committee deems it most advantageous to have the store-door delivery a carrier service, but at additional rates not included in the through rates," and also that "the carrier assume liability for the safe transfer by their representatives, a reasonable charge to be assessed for such service."

The subcommittee presenting the plan to the railroads is composed of A. E. Beck, general traffic manager Merchants' & Manufacturers' Association, Baltimore; J. C. Lincoln, general traffic manager Merchants' Association, New York; William J. Pitt, general traffic manager John Lucas & Co., Philadelphia; T. T. Harkrader, general traffic manager American Tobacco Co., New York; W. J. L. Banham, general traffic manager Otis Elevator Co., New York, and Dr. R. S. MacElwee, director Bureau of Foreign and Domestic Commerce, Washington, D. C.

A. A. E. Has 24,026 Members

The American Association of Engineers on Jan. 13 had 24,026 members. Two years ago on that date the membership was about 2,400.

The New Administration of the Am. Soc. C. E.

In this and succeeding issues of "Engineering News-Record" will appear brief biographical sketches of the newly elected officers and directors of the American Society of Civil Engineers, as announced in the issue of Jan. 20, p. 140, following the annual meeting.

Richard L. Humphrey, Director

Richard L. Humphrey, director, District 4 (Philadelphia). former chairman of the Joint Conference Committee of national engineering societies which created the Federated American Engi-

RICHARD L. HUMPHREY

neering Societies, was born in Marblehead, Mass., in 1869. After graduation as civil engineer from the University of Pennsylvania in 1891 he joined the engineering staff of the Philadelphia & Reading Ry. as draftsman and from there went to the Bureau of Surveys, Philadelphia, to design sewers and bridges.

In 1892 Mr. Humphrey became engineer in charge of the Philadelphia municipal testing laboratory where he served until 1899, leaving the municipal service in that year to become engineer and general manager of the Buckhorn Portland Cement Co., in which capacity he served until 1903.

He entered consulting practice in 1903, specializing in the inspection of materials and examination of cement properties; he served as expert for the Pennsylvania R.R. in condemnation proceedings and as adviser to a number of cement companies. For five years, from 1905 to 1910, he acted as engineer in charge of structural materials testing laboratories at St. Louis, Pittsburgh, and Atlantic City, and from 1910 to date has been consulting engineer to the U. S. Bureau of Mines.

Mr. Humphrey has taken an active part in engineering society affairs and is a member of a great many organizations in which he has held office and served on committees. He was one of the organizers and the first secretary (1898-1900) of the American Society for Testing Materials. When the American Concrete Institute was organized Mr. Humphrey served as its first president from 1913 to 1915. Among his other society activities have been the following: Secretary, Joint Committee on Concrete and Reinforced Concrete, 1904-15; secretary, Committee on Uniform Methods of Tests for Cement and Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers; secretary, Joint Conference Committee on Uniform Methods of Tests and Standard Specifications for Cement; and chairman (1918 to date) Committee on Reinforced Concrete, American Society for Testing Materials. He was a member of the American Society of Civil Engineers' Committee on Development and served as chairman of the Joint Conference Committee representing the founder societies, which was instrumental in creating the Federated American Engineering Societies.

During the war Mr. Humphrey served as director of the Building Materials Division of the Council of National Defense.

Baxter L. Brown, Director

Baxter L. Brown, director, District 9 (St. Louis, Mo.), is a consulting engineer and former chief engineer of the St. Louis Valley Ry. He was born in Rush, N. Y., in 1864 and began engineering work in 1882 as axeman on the Continental Ry. He has had an extensive experience in railway engineering work, having served on location, construction and maintenance with a variety of roads in all capacities from axeman to chief engineer. He has, at various times, been connected with the Missouri Pacific, the Wabash, the St. Louis, the Iron Mountain & Southern Ry., and many others. Structures built under his direction include a 1,400-ft. steel viaduct 85 ft. high across the Kaskaskia River at Shelbyville, Ill.; terminals, piers and ship channels at Port Arthur, Texas; and a wide variety of other works incident to railroad construction and maintenance.

After twenty-three years of railway work Mr. Brown entered private practice as consulting engineer with offices in St. Louis, specializing in railroads and allied subjects. In 1912 he was retained by the City Plan Commission of St. Louis as consulting engineer to report on the development of the river front, and in 1916 was one of a committee of five engineers who reported to the Chamber of Commerce on the general industrial and civic improvement of St. Louis. As consulting engineer of the Aluminum Ore Co. Mr. Brown advised on river transportation on the Mississippi and on the construc-

BAXTER L. BROWN

tion of suitable terminals for the interchange of freight between river and rail.

Indiana Water Supply Meeting Strictly Technical

The two-day convention of the Indiana Sanitary and Water Supply Association, Feb. 16 and 17, in Indianapolis, was strictly a technical meeting. Even at the banquet the after-dinner moving picture entertainment got no farther away from the technical than to show six reels made (by animated maps) for the Sanitary District of Chicago of the former pollution conditions along the lake front and then of a trip the length of the channel to Lockport and, finally, the fishing and clam shell industries on the Illinois River.

Two round table discussions were held on problems of the superintendence, extensions and payment for service connections. Other main topics were: (1) Water purification of pollution conditions in the Calumet region, the tuning up experiences at the recently built plants at Whiting and East Chicago furnishing the point of these discussions; (2) city planning and its relation to utilities and housing development.

Two bills now before the State legislature relating to city planning and zoning, giving cities the power to establish city plan commissions, were approved by the only resolution acted upon. A committee on affiliation or amalgamation with the American Water-Works Association recommended that the question be laid on the table for another year.

The officers elected for the ensuing year are as follows: President, Charles Brossmann; vice-presidents, J. B. Marvin, H. E. Jordan, John C. Davis, George L. Smith and L. Elliott; secretary, C. K. Calvert; assistant secretary, Charles J. Miller.

Federation to Study Government Department Reorganization

The American Engineering Council, of which Herbert Hoover is president, has decided to enter actively upon a broad plan for the reorganization of federal government departments, it has been announced. Up to this time the organized engineers of the nation have confined their efforts principally to the Department of the Interior, which they seek to make over by establishing a national department of public works.

River Drainage Board Created

Governor McCray of Indiana has signed a bill to create a Kankakee river drainage commission, which will confer with a similar commission in Illinois to view the proposed straightening and deepening projects and report back to the Governor. The bill provides for an appropriation of $1,000 for expenses.

Sewage Tank Troubles Feature of Meeting at Trenton

A feature of the annual meeting of the New Jersey Sewage Works Association at Trenton, Feb. 18, was a discussion of single-story sewage settling tanks, with occasional remarks on two-story tanks. There was also an address on the "Biology of Sewage Disposal" by Dr. Thomas J. Headlee, of the State Experiment Station, New Brunswick, and a paper by Weston Gavett, New York City, outlining the development of sewage siphons, illustrated by charts and further elucidated by a demonstration with a model (see *Engineering News-Record*, Nov. 25, 1920, for an article by Mr. Gavett covering a part of the same ground).

C. M. Nichols, of the engineering bureau of the New Jersey State Department of Health, in his paper on the design and operation of "Single-Story Tanks" described a design for such a tank in duplicate, with a separate sludge-digestion tank between, and I. R. Riker, also of the bureau just named, presented considerable data on tank difficulties and means of overcoming them. The ensuing discussion by John R. Downes, of the Plainfield Joint Sewage Works, Mr. Collins of Collingswood, Mr. Molitor of the Chatham-Madison plant, and others, showed that the tank problem is a live subject in New Jersey. Later, Mr. Downes presented some Riensich-Wurl screen and Imhoff tank data from Plainfield.

Dr. Headlee, in the course of the address already mentioned, expressed the hope that the sewage research work being done at New Brunswick will throw light upon optimum conditions for the action of enzymes in changing organic to inorganic matter.

Chester G. Wigley, engineer with Clyde Potts, 30 Church St., New York City, was re-elected as president of the association and Myron E. Fuller, with Fuller M. McClintock, engineers, 170 Broadway, New York City, was chosen as secretary and treasurer.

Municipal Ownership for Chicago Street Railways

A municipal transportation district for Chicago, with power to issue bonds up to 5 per cent of the assessed valuation for the purpose of building or buying street car lines, is the proposal of a traction commission appointed some months ago by the mayor to find a method of providing a municipal street railway system and of operating it at a 5c. fare. At present such a bond issue would not exceed $80,000,000. Recognizing that a 5c. fare might not pay expenses, the plan authorizes the trustees of the proposed district to levy taxes to make up any deficit. A legislative bill has been drafted authorizing the creation of such a bonding district, the question then to be submitted for public vote for the acceptance of the plan and for the election of six trustees. The plan will go first to the Chicago City Council Committee on Local Transportation, and if approved the bill will then be presented to the State legislature.

Cornell Colleges of Engineering to Combine

At the recent meeting of the board of trustees of Cornell University the long projected consolidation of the various engineering colleges was ordered to take place at the close of the present term. This means that Sibley College of Engineering, which comprises courses in mechanical and electrical engineering, and the College of Civil Engineering will be merged in an Engineering College.

Professor D. S. Kimball, of Sibley College, has been chosen as dean of the newly created Engineering College, and the separate schools of mechanical, civil and electrical engineering will be headed by professors now in the respective schools. Herman Diederichs will be head of the school of mechanical engineering, Fred A. Barnes of civil engineering, and A. M. Gray of electrical engineering.

Sue to Void Bond Issue for Viaduct

Action has been begun by R. A. Baskin, retiring county prosecutor of Cuyahoga County, Ohio, to restrain the county commissioners from selling bonds for the proposed Lorain-Huron viaduct across the valley of the Cuyahoga River in Cleveland. A permanent restraining order is asked, on the ground that the 1914 referendum vote authorizing the issue of $5,000,000 for constructing the viaduct is void. It is urged that the county's bonded debt has increased, that the bonds now can not be sold unless they carry much higher interest than in 1914, that the amount of the authorized issue is no longer sufficient to build the bridge, and that the plan for the work includes river diversion, which was not covered by the referendum, which, it is contended, is necessary.

First Power License Issued by Federal Commission

On Feb. 28 the Federal Power Commission granted the first 50-year license under the new Water Power Act to the Niagara Falls Power Co. to use 19,500 cu.ft. per sec. from the Niagara River at Niagara Falls. This amount is now being used by the company under old permits. The international treaty at present in force limits the United States use at this point to 20,000 sec.ft.

Bridge Load Limitation by County Upheld in Ohio

Load limits placed on county bridges by the Commissioners of Mahoning County, lower than the state road law limit of 12 tons at the maximum weight of a truck, has been upheld as lawful by Judge Cooper of the Court of Common Pleas, Youngstown, Ohio. Suit was brought by trucking interests in a suit to enjoin the county from arresting persons attempting to cross the bridges wtih loads higher than the limit fixed. Their contention was that the county limitation conflicted with the state limitation. Judge Cooper held it a fact that there was no conflict between the laws and that the Commissioners at all times had the right to make regulations necessary to protect public property.

Wisconsin Engineers Want School for Architects

In the opinion of the engineers of Wisconsin, as expressed at the annual meeting of the Engineering Society of Wisconsin at Madison, Feb. 21 and 22, there is a deficiency of architects in that state. In consequence they recommended to the officials of the State University that a school of architecture be established.

Concurrence was also given with the recommendations of A. R. Hirst, state highway engineer, in the statement accompanying his recent resignation (see *Engineering News-Record*, Feb. 10, p. 265) that immediate steps be taken to insure efficiency and non-political control of roads and other public works. A resolution to this effect was directed to the state legislature. Another resolution addressed to the same body called for an annual appropriation of not less than $18,000 for the engineering division of the State Board of Health. Approval was given to the Great Lakes-St. Lawrence River deep waterway project.

Two sessions were held jointly with the Wisconsin State Drainage Association which resolved to work for the appointment of one of their members on the State Real Estate Board which, it is alleged, is selling off cut-over lands in preference to drainage lands.

The newly-elected officers are as follows: President, Charles I. Corp; vice-president, Jerry Donohue; secretary-treasurer, Prof. Leonard S. Smith, Madison.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The San Francisco Section, Am. Soc. C. E., devoted its bi-monthly meeting Feb. 15 to a symposium on land improvement work in the central California flood basins. **Fred H. Tibbetts**, irrigation engineer, spoke on "Development Under Way and Projected"; F. S. Cooper of the Olympian Dredging Co., dealt with "Construction and Operation of World Record Dredges"; and Robert Shurman of the Byron Jackson Iron works, discussed "Installation of Large Drainage Pumps." The papers brought out the fact that in this flood basin the present value of more than 1,500,000 acres of rich land have been created almost entirely by engineering work and that dredges of unique design (booms up to 240 ft. long with 7¼ cu.yd. buckets) and pumps of enormous capacity (180,000 gal. per minute) have been developed to meet requirements peculiar to these valleys. The section endorsed the plan of urging the appointment of an engineer to the Interstate Commerce Commission and authorized sending a letter to that effect to Congressmen from California. It was voted unanimously to endorse the action of the special meeting on Feb. 4 at which the so-called Marshall plan (see *Engineering News-Record*, Feb. 10, p. 273) was condemned.

The Colorado Society of Engineers recently elected the following officers: President, F. C. Dreher; vice-president, R. M. Hosea; secretary, C. M. Lightburn. Educational extension courses are again being given in co-operation with the University of Colorado. In co-ordination with the Colorado Engineering Council the society has introduced a revised license law into the legislature.

The Southwest Water Works Association, Waco, Tex. will hold its convention May 9-12 at the Skirvin Hotel, Oklahoma City, Okla. Papers will be read by members of the State Boards of Health of different States. E. L. Fulkerson, Waco, Texas, is secretary of the association.

The New England Water Works Association, at its meeting March 9 in Boston, will be addressed by **Nicholas S. Hill, Jr.**, on "Pipe Extension Charges" and by **William R. Conard** on "Cast Iron Pipe, the Method of Manufacture and its Inspection."

The Florida Engineering Society, at its convention held recently at Lakeland, elected the following officers: President. C. S. Hammatt; vice-presidents, G. R. Ramsey and W. W. Fineren; secretary, Dr. J. R. Benton; treasurer, C. H. Ruggles.

PERSONAL NOTES

A. G. WULFF has been appointed Cincinnati representative of the Highway Iron Products Co., of Ligonier, Ind.

ROBERT O. DERRICK has been admitted as partner to the firm of Brown, Preston & Derrick, architects and engineers, Detroit, Mich.

W. L. HOFFEDITZ, special paving engineer of the city of Twin Falls, Idaho, has been appointed city engineer of Colorado Springs, Col. During the war he was captain with the 23d (Highway) Regiment of Engineers and served as regimental adjutant.

DONALD C. ELDER has been appointed engineer of Marshall County, Iowa.

W. R. WEBSTER has resigned as assistant chief engineer of the Cambria Steel Co., Johnstown, Pa., to become general engineer of the Semet-Solvay Co., Syracuse, N. Y.

CHARLES SMITHLEY has been appointed engineer of Geary County Kan., to succeed G. A. Russell, resigned.

PATRICK PHILIP has been appointed chief engineer of the Public Works Department of British Columbia.

CLARENCE N. STEEVES of Sussex, N. B., formerly chief engineer Maritime Dredging & Construction Co., has been appointed assistant engineer of the Department of Railways & Canals at Cornwall, Ont.

GEORGE P. MACLAREN, formerly district engineer, Ontario Distdict, has been appointed engineer maintenance of way, Eastern Lines, Canadian National Railways.

S. W. DUDLEY has resigned as chief engineer of the Westinghouse Air Brake Co., Wilmerding, Pa., to accept a professorship in mechanical engineeering at Yale University.

R. F. MACDONALD has been appointed county sanitary engineer, Cuyahoga County, Ohio, in charge of a new department created under the county sewer district law of Ohio, for the purpose of designing and construction water and sewerage improvements in unincorporated sections of the county, and not county engineer, as recently announced. W. A. Stinchcomb is county engineer.

POWELL & JACOBS is the name of a firm of consulting civil engineers recently organized by Joseph Jacobs, formerly lieutenant-colonel, and Archibald O. Powell, formerly major, Engineers, with offices in Seattle, Wash. Special attention will be given to irrigation, drainage and diking, river and harbor improvement, docks and terminals, water works and sewerage systems, water powers, dams, also utility valuations and consultation in connection with engineering arbitrations and cases before the courts.

COL. FRANCIS A. POPE, Corps of Engineers, U. S. A., in charge of the U. S. District Engineer's Office at Duluth, has been transferred to Manila, P. I., where he will have charge of defensive works and command the 14th Engineers. Major Edwin R. Marks, Office of the Chief of Engineers, at Washington, will succeed Col. Pope at Duluth.

DONALD G. COOMBS, for three years with the Braden Copper Co., Rancagua, Chile, as assistant division engineer and office engineer on the construction of a 10,000-ton copper smelter at Caletones, Chile, has returned to the United States and will be permanently located in Seattle, Wash., he will continue in construction work. Mr. Coombs, before going to Chile, was for three years assistant superintendent of construction for the U. S. Reclamation Service on the construction of the Meadow Creek and Rimrock dams.

N. C. HOYLES has been appointed manager of the Cincinnati, Ohio, branch of the Pittsburgh Testing Laboratory. For the past year he has been assistant manager of this company's New York office and from 1909 to 1914 he was manager of the Birmingham, Ala., branch of the company. During the war he was overseas with the Canadian Engineers and was mustered out with the rank of lieutenant-colonel.

J. BROWER, JR., formerly with S. Diescher & Sons, engineers, Pittsburgh, Pa., is now designer with the Kelly-Springfield Tire Co., at its new plant at Cumberland, Md.

CARL C. WIDENER, former city engineer of Bozeman, Mont., and C. A. Truitt, formerly of Burns & McDonnell of Kansas City, have associated as consulting engineers with offices in Bozeman. They will specialize in municipal and hydraulic engineering.

ROBERT D. TRIPP, a former city manager and city engineer of Petosky, Mich., has been engaged as road engineer for Emmett County, Mich.

MAJOR G. T. LEMMON, for the past two years with the Virginia State Highway Commission as resident engineer in charge of work in 13 counties has been transferred to the Richmond

residency in charge of 15 counties. During the war he served in the army as major, Engineers.

WILLIAM B. REED, of Weedsport, N. Y., has been named third deputy commissioner of highways with headquarters at Albany to succeed Charles Van Amburg of Binghamton. He has been district supervisor of the highway department since 1910 in charge of the roads of seven counties in Central New York.

CHARLES F. PUFF, JR., has resigned as engineer in the Highway Bureau of Philadelphia to become secretary and general manager for the Associated Pennsylvania Highway Contractors, with headquarters at Harrisburg.

COL. W. G. ATWOOD, formerly chief engineer, Lake Erie & Western R.R., and section engineer, Base Section 1 of the A. E. F., at St. Nazaire, France, has been appointed manager of the newly established office at St. Louis, Mo., of the Woods Brothers Construction Co., of Lincoln, Neb., owners of the patents for the Bignell concrete pile.

OBITUARY

FREDERICK C. MIERON, an engineer with the New Jersey State Highway Commission, died Jan. 19 at Lakewood, N. J. He was a graduate of Princeton University.

FRANK C. PEARL, civil engineer, died Jan. 10 at Spokane, Wash. He was born in Oakfield, Iowa, in 1865. He was a civil engineer with the Great Northern Ry. and the Washington Water Power Co. During recent years he had been engaged in county road work.

JOSEPH P. ARP, building contractor, died Feb. 9 at Sioux City, Iowa. He was born in Comanche, Iowa, 1860. He constructed nearly 100 banks, churches and business blocks in northwestern Iowa.

JOSEPH C. ROCK, general agent for the United States Asphalt Refining Co., New York, and for many years an official of the Barber Asphalt Paving Co., died in New York at the age of 75. He was one of the pioneers of the asphalt paving business and introduced this class of pavement throughout many cities in the United States twenty-five and thirty years ago. He was president of a company which did a large amount of asphalt paving for the Borough of Manhattan. Mr. Rock served throughout the Civil War with a Vermont regiment. Subsequently he was connected with several government departments in Washington. He moved to New York in 1889 to accept the post of secretary with the Barber Asphalt Paving Co.

The Business Situation as Viewed from Three Special Angles

Long Period of Cautious Buying on Slowly Declining Market Seen—Foreign Situation Among Leading Factors To Consider

Believing they could well serve their respective readers through an interchange of thought upon the present and future condition of business, the editorial conference of the New York Business Publishers Association discussed at a luncheon Feb. 18 the situation in the so-called key industries. From the discussions there presented, the following three have been abstracted in order to present to Engineering News-Record readers, the opinions of those men in a position to judge of the conditions in their respective fields.—EDITOR.

IRON AND STEEL

BY A. I. FINDLEY, Editor, *Iron Age*

The iron trade did not function as a barometer in the early stages of the present readjustment. After Japan in May, 1920, pioneered in deflation through the collapse of the silk trade, other mercantile lines in the United States started price declines. The collapse in the steel trade did not come until October. Whether this means that the steel trade will still be readjusting when other lines have become fairly stabilized is yet to be determined. What is certain is, that the steel trade is today in a depressed state, and that those who in November looked for a moderate revival in the spring of 1921 are now setting the date for any marked improvement some months further on in the year. There is a growing belief that present conditions in the United States are due more than we were willing to believe last year to financial and industrial straits of Europe. As never before, leaders in industry and finance in this country see that we are linked up with the rest of the world for better or worse.

In view of its basic character, developments in the steel trade are important as an index to what is to be expected in 1921. Today there is about two-thirds operation of iron and steel works, with the possibility that with the coming of spring a temporary spurt in demand may bring the percentage up to 75. It has been found in other times of depression that wear and tear alone is good for about a 60 per cent operation in iron and steel.

PRICE SITUATION

At present a disproportionate share of the steel going into consumption is coming from plants of the United States Steel Corporation. The reason in brief is that the Steel Corporation ever since March 21, 1919, has adhered to the so-called Industrial Board prices which were announced at Washington on that date. Independent steel producers in the last half of 1919, and all through 1920 till the slump came, were able to get higher prices due to the inadequate supply of steel caused by various strikes and by the prolonged inability of the railroads to function normally. There was also at work a psychological scarcity due to the excited effort of automobile manufacturers and others to get hold of steel at any price to meet the apparently insatiate demand of the luxury spenders of 1919 and 1920. The exhaustion of the country's ability to consume steel at premium prices left some of the independent producers with little business on their books. Recently one of these companies decided to go out for business at prices below the Industrial Board level maintained by the Steel Corporation, and the immediate, and thus far unanswered, question before the trade is to what extent these cuts in prices will stimulate business. Wage reductions of 15 to 25 per cent have been made or are about to be made by most of the important independent steel companies. The Steel Corporation has not reduced wages thus far.

OUTLOOK

The outlook for an early and extensive revival of demand for iron and steel is not favorable. The fall in prices of agricultural products has reduced very much the demand for agricultural improvements. The implement works have considerable stocks of steel. The railroads, which, in average times, take from 20 to 25 per cent of the steel output, are buying little, rails and track accessories having been in best demand. Until the railroads are freed from the strangle-hold of the wasteful labor scheme imposed on them by the Government, they will not be free buyers of equipment. Today they have many idle cars with no early prospect of full use of their equipment.

A great many building projects would be put through if labor and materials in construction lines were at a point which would justify investing.

The automobile building program for 1921 can hardly be more than 40 per cent of that for 1920. The automobile industry has probably not taken more than 5 or 6 per cent of the country's steel output on the average, but its ramifications are such that it has been a very important sustaining factor.

Shipbuilding demand for steel in 1921 is likely to be considerably less than in 1920. Mining, whether of coal, iron or non-ferrous minerals, will be restricted in 1921. So far as iron, copper and other metals are concerned operations of the mines this year can hardly go beyond 60 or 70 per cent of last year.

Export trade in steel fell off rapidly in the latter part of 1920, with increasing competition from Germany, Bel-

gium and France in world markets, and with the reduced buying power of countries which do not have an iron and steel industry, it is not likely that the 1921 shipments from the United States will go beyond 60 per cent of those of 1920.

The most favorable indication industrially for the present year is the evidence of a return to economic production methods. It will be a good thing for producers to learn again how to sell their products. For a long time things have been bought rather than sold. There will be a great gain in the revival of the profession of salesmanship, and salesmanship will mean the right price, which is something the country has not known for a good while.

It would be a misfortune if any of the patent methods of restoring the industrial pace of early 1921 could be made to work. We shall not get rid in a month or in six months of the vicious practices which have controlled manufacturing, buying and selling in the United States during the war and since. The worker has been getting out of industry a good deal more than he put in. Profits in many lines have been inordinate. The Government paid the bill, meanwhile borrowing to the limit from the people. The game had a certain exhilaration while it lasted, but now the old way of working and saving must be learned over again. We may look for a good deal of progress along this old-fashioned road in 1921, and that, at the moment, is one of the most encouraging things in the outlook.

Chemicals

By Williams Haynes, Editor, *Drug and Chemical Markets*

The average price of twenty representative industrial chemicals was run up to a peak in July of 1920 that was 500 per cent above the pre-war level. Shortly after the Japanese panic, domestic demand for chemicals began to drop, as our rubber, fur, silk, woolen, cotton, and other industries began to curtail or shut off production. Reflecting the industrial stagnation of the country, since last July there has been virtually no sale for heavy chemicals. The fall in prices was very sharp, amounting to 60 per cent from last August until January of this year. Since then the decline has slowed up, which indicates that distressed stocks in second hands are being gradually absorbed and that producers are again gaining control of the market.

Prices are today a symptom and not a cause. Price cutting—even violent price cutting—has not resulted in sales, and it means nothing to buyers that many chemicals are selling today below the actual cost of production tomorrow. The situation in chemicals, as in other lines, depends primarily upon the absorption of existing stocks, which must be consumed before business will be resumed. In so wide a field as chemicals, there are always numerous exceptions, but, speaking broadly, chemical prices have been pretty thoroughly "deflated," and if there is a brisk consumer demand, may be expected to rise, temporarily at least, to offset the present cost of production. That prices, after existing stocks are cleaned out, will be much lower, is not possible until fuel, labor, and freight are reduced.

Forecast

Very recently there has been in the New York market a small, but marked demand from actual consumers. Reports from Boston and Philadelphia tell also of cautious orders for chemical supplies, but in Cleveland, Chicago, and St. Louis, the inquiry stage of business has, as yet, only been reached. These orders for chemicals from other industries forecast, if sustained, a resumption of industrial activity.

After existing stocks of finished products and crude materials have been consumed; when the depressed foreign exchange has been more nearly equalized; after labor costs and freight rates have been lowered—then, chemical prices will go lower.

The development of the coal-tar products gives us now a complete, self-contained American chemical industry, which makes every other American industry independent of foreign sources of these essential chemical supplies. The cost of chemicals to American manufacturers in all lines will eventually be brought lower because of increased selling competition among American chemical producers and constant improvements in chemical manufacturing processes.

The beginning of the end of the present readjustment period is indicated by the tangible demand for chemicals for industrial purposes, and after readjustment, we may expect a long period of gradually lowering prices coincident with gradually falling costs of labor, crude materials, power, and freight. In all lines similar conditions will obtain. American business faces a long period of cautious buying in gradually declining markets.

Temper of the Buying Public

By S. H. Ditchett, Editor, *Dry Goods Economist*

Because of the prolonged semi-cessation of buying by retailers, apprehension had been felt that when they reentered the markets for spring purchases there might develop a recurrence of the recent scramble for merchandise, resulting in a price boost. We did see a price advance put into effect by some manufacturers of cottons, and also in silks. But manufacturers' stocks were heavy because of recent cancellations, and distributors have not fallen over themselves to buy goods, and so—except in one or two lines of cottons and in one or two lines of silks—there has been no merchandise scarcity, no price flurry. For once, the retailers stuck to their determination, and, doing so, they bought conservatively.

What of the future? Too many factors are operative to permit of more than enumeration here. Our export trade, now declining, but with prospect of a broader, more intelligent, more cooperative effort for its development. The certainty of increased imports even after the enactment of a new tariff law. The continuance of the restrictions on the accumulation of capital through the action of the excess profits taxes and the income surtaxes. The uncertainty as to the reparations sum to be paid by Germany, including what the United States is to get. The delay in resuming trade relations with Russia, although, judging by the King's speech to Parliament, Great Britain appears to be on the eve of resumption. The labor situation in our own country, especially as regards the railroads and their employees, and in its direct relation to many department stores because of the dispute in the men's clothing industry. All these conditions have a pronounced bearing on supply and demand, on trade and on prices.

I, for one, believe we can look for no permanent advance of any importance in the prices of textiles. The recent stiffening in a few lines will be maintained perhaps, because they seem, prior to the advance, to have been marked too low. But with declining exports and increased imports the supply is going to increase. Remember that we produce in this country of products of all kinds 25 per cent more than we can consume. Remember, too, that on certain lines of commodities, notably, china, glassware, enamelware and other household stuff there have as yet been no price reductions, and that on other lines, notably furniture, rugs and carpets, the price reductions so far are inadequate.

Take all these facts into consideration, take the world situation, and I believe you will reach the conclusion that price changes will be downward.

The situation is a novel one to the present generation. But, as a Cleveland banker pointed out the other day, our fathers did business all their lives on a falling market. Even if prices should continue to decline for an indefinite period there is no reason to doubt that the merchants and manufacturers of today will succeed in adapting themselves and their methods to the needs of the hour.

Maps of Coal Mines Under Cities Must Be Filed

By resolution of the city council of Wilkes-Barre, Pa., coal-mining companies operating under the city are required to file maps of their workings with the city clerk. This ordinance is the outcome of demands by a delegation of housewives, who gave expression to general alarm felt in parts of the city over the liability of disaster from mine caving.

Spring Prices of Construction Materials Since 1913

Present New York Level 120 per Cent Above 1913—Freight Up 138 per Cent—Checking Up Our Thought of 1919

Engineering News-Record's Comparison of Spring Prices of Construction Materials was first published in the issue of Jan. 16, 1919, and again on Feb. 12, 1920. It has been brought up to date and is again offered in expanded form. The tabulation, instead of dealing solely with the New York market, as heretofore, includes Pittsburgh mill quotations for structural shapes, reinforcing bars and steel sheetpiling. The list is rounded out by the addition of the Southern pine base in New York.

The table should be carefully studied before using. It will be seen that in the case of cement, for example, the quotations, 1913 to 1918, inclusive, are "alongside dock," New York, whereas subsequent prices are "on the job" and include trucking charges. This is the reason why no general average is given for cement. Also, our cement quotations are exclusive of bags, the charge for which varies from 10 to 25c. For the last two years or so we have quoted cement net or exclusive of sacks, in the "Monthly Prices of Construction Materials," (see p. 406 of this week's issue).

First, compare present prices with those of pre-war days—the spring of 1913. Percentages above the levels of that period are as follows: Lumber, 31; structural shapes, Pittsburgh mill, 33; reinforcing bars, Pittsburgh mill, 50; bars, New York warehouse, 61; structural shapes, New York warehouse, 67; steel sheetpiling, Pittsburgh mill, 88; linseed oil, 99; tank plates, New York warehouse, 135; crushed stone, 139; sand, 150; cast-iron pipe, 169; building tile, factory, 170; gravel, 243; cement, net, 163; freight from Pittsburgh to New York or Chicago, 238.

In January, 1919, we suggested that a reasonable price schedule might be the average spring prices from 1913 to 1918. We repeat that suggestion, tentatively: Would not a reasonable schedule for the spring of 1920 be in many instances the average spring prices from 1913 to 1920 inclusive? The steel and lumber industries, at least, appear to agree with this idea.

PRICE SITUATIONS IN SPRING, 1919 AND 1921
(+ indicates increase; — indicates decrease)

Materials	Per Cent Change, January, 1919, from General Average of Spring Prices, 1913–18	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913–20
Crushed stone	+ 42	+ 61
Sand	+ 100	+ 42
Gravel	+ 120	+ 111
Cast iron pipe	+ 91	+ 45
Structural shape	+ 52	+ 14
Tank plates	+ 58	+ 17
Linseed oil	+ 62	— 36
Freight Pittsburgh to New York or Chicago on finished steel products	+ 35	+ 95
Steel sheetpiling, Pittsburgh mill	+ 105	+ 10
Structural shapes, Pittsburgh mill	+ 56	— 6
Reinforcing bars, Pittsburgh mill	+ 58	+ 6
Reinforcing bars, New York warehouse	+ 51	+ 11
Average	+ 69	+ 31

ENGINEERING NEWS-RECORD COMPARISON OF SPRING CONSTRUCTION MATERIAL PRICES SINCE 1913
All Prices New York Except Otherwise Stated

	Portland Cement, per bbl. net, at Buffout to 1918	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone, (per Cu.Yd., 2 In.)	Sand (per Cu.Yd.)	Gravel (per Cu.Yd., 2-in.)	C.-I. Pipe (6 In., per Ton)	Beams and Channels (3—15-inch per 100 Lb.)	Beams, Etc., Pittsburgh Mill	Reinforcing Bars, 1-in. and Larger Pittsburgh Mill	Reinforcing Bars, 1-in. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates 1-in. and heavier per 100 Lb.	Hollow Tile (6x12x12 per Block), Factory Perth Amboy, N. J.	Linseed Oil (Raw in Barrels)	Freight to Pittsburgh on Steel (per 100 Lb.)
April, 1913	$1.18	$42.00	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.084	$0.48	$0.16
May, 1913	1.18	42.00	7.00	.90	.50	.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	.084	.50	.16
June, 1913	1.18	42.00	7.00	.90	.50	.85	23.00	2.15	1.50	1.50	2.25	1.60	1.61	.084	.48	.16
Average	$1.18	$42.00	$7.00	$0.90	$0.50	$0.85	$23.50	$2.15	$1.62	$1.50	$2.25	$1.60	$1.61	$0.084	$0.49	$0.16
April, 1914	$1.18	.....	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.084	$0.54	$0.16
May, 1914	1.18	.....	5.50	.95	.50	.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	.084	.54	.16
June, 1914	1.18	.....	5.60	.95	.50	.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	.084	.53	.16
Average	$1.18	.....	$5.55	$0.95	$0.50	$0.90	$21.50	$1.85	$1.13	$1.17	$2.25	$1.60	$1.31	$0.084	$0.54	$0.16
April, 1915	$0.82	.....	$5.50	$0.90	.....	$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36	.....	.....	$0.169
May, 1915	.82	.....	5.75	1.05	.....	.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32	.....	.....	.169
June, 1915	.82	.....	6.00	1.05	.....	.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37	.....	.....	.169
Average	$0.82	.....	$5.75	$1.00	.....	$0.85	$20.75	$1.90	$1.18	$1.17	$1.97	$1.53	$1.35	.....	.....	$0.169
April, 1916	$1.32	.....	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50	.....	$0.81	$0.169
May, 1916	1.32	$31.50	7.25	.95	.40	.85	.....	2.50	2.75	2.50	3.25	2.50	2.65	.....	.81	.169
June, 1916	1.32	31.50	8.00	.95	.50	1.00	.....	2.60	2.75	2.50	3.10	2.50	2.75	.....	.....	.169
Average	$1.32	$31.50	$7.90	$0.95	$0.45	$0.90	$30.50	$2.55	$2.67	$2.47	$3.15	$2.50	$2.65	.....	$0.81	$0.169
April, 1917	$1.52	.....	$9.50	$1.20	$0.50	$1.25	$47.50	$3.75	.....	.....	.....	.....	$5.00	.....	$1.04	$0.169
May, 1917	1.80	.....	11.50	1.25	.50	1.35	55.50	3.80	.....	.....	.....	.....	5.50	.....	1.21	.169
June, 1917	1.80	.....	10.25	1.25	.50	1.25	55.50	5.00	.....	.....	.....	.....	7.00	.....	1.31	.169
Average	$1.71	.....	$10.40	$1.25	$0.50	$1.30	$51.70	$4.15	.....	.....	.....	.....	$5.80	.....	$1.19	$0.169
April, 1918	$1.99	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	0.14	$1.55	$0.195
May, 1918	1.99	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	.14	1.55	.195
June, 1918	1.99	43.25	10.25	1.75	1.25	2.00	61.35	4.20	3.00	2.90	4.09½	4.00	4.45	.14	1.58	.195
Average	$1.99	$43.00	$10.15	$1.75	$1.25	$2.00	$57.35	$4.20	$3.00	$2.90	$4.09½	3.70	$4.45	$0.14	$1.56	$0.195
April, 1919	$2.05†	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.159	$1.55	$0.27
May, 1919	1.90†	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	.153	1.63	.27
June, 1919	1.90†	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	.153	1.76	.27
Average	$1.95†	$45.50	$15.00	$1.75	$1.25	$2.00	$56.03	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.155	$1.68	$0.27
April, 1920	$2.80†	$72.00	$25.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.2274	$1.87	$0.27
May, 1920	3.20†	70.00	25.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	.2274	1.87	.27
June, 1920	3.30†	70.00	25.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	None	1.73	.27
Average	$3.10†	$70.50	$25.00	$2.10	$1.42	$2.58	$74.97	$4.83	$4.00	$3.92	$5.00	$3.65	$4.89	$0.2274	$1.83	$0.27
General average	.....	$46.50	.....	$1.33	$0.88	$1.42	$43.70	$3.14	$2.29	$2.21	$3.16	$2.73	$3.22	$0.1125	$1.15	$0.195
March, 1921	$3.10	$55.00	$22.70	$2.15	$1.25	$3.00	$63.30	$3.58	$2.15	$2.35	$3.63	$3.00	$3.78	$0.2274	$0.73	$0.38

† Delivered on job, instead of alongside dock as in previous years.

February Contracts Exceed Those of January

A considerable increase in the value of contracts let during February, 1921, particularly in the construction of miscellaneous building, is the outstanding feature in a comparison of contracts let during January and those let during February, as reported in *Engineering News-Record*. The actual increase in all contracts reported during February over the preceding month was 15½ per cent, though in contracts let for the construction of apartments, educational buildings, churches, hospitals, theaters hotels, bank and office buildings, lofts, and buildings of a similar nature, the increase was 82 per cent. The money value of all contracts let during February aggregated $62,906,821, whereas in January this figure was $54,408,367, as indicated in *Engineering News-Record*, Feb. 10, p. 279.

During February, 1920, there was a decrease of 15 per cent in the money value of contracts awarded as compared to the preceding month. The money value of contracts let during January, 1921, was 31 per cent of contracts let during January, 1920, whereas February contracts were 42 per cent of those let during January, 1920. The largest single item noted during February is an allotment of $5,000,000 for work undertaken by the Detroit Street Ry. Co.

Following is a tabulation of the money value of contracts awarded in February, 1920 and 1921:

Classification	February 1920	February 1921
1—Waterworks	$2,171,725	$927,307
2—Sewers	622,874	2,445,075
3—Bridges	2,137,393	885,529
4—Streets and roads	21,334,013	12,049,344
5—Railways	20,000	6,350,000
6—Excavation, dredging	786,943	305,740
7—Industrial works	63,262,290	4,737,850
8—Buildings	52,200,466	31,902,608
9—Federal government	2,282,373	1,574,927
10—Miscellaneous	3,466,519	1,728,441
Total	$148,284,596	$62,906,821

Hettrick, Code of Practice Author, Guilty of Conspiracy

John T. Hettrick, a New York City attorney, has been found guilty of conspiring to force plumbing contractors into his "code of practice" clearing house for bids in the plumbing industry. Together with William H. Chapman, William J. Doran, and Herbert Smith, Hettrick was found guilty Feb. 25, in the New York supreme court. All four defendants were sentenced to from six months to three years in the penitentiary.

The conviction of Hettrick and his co-defendants, two of whom were walking delegates for the plumbers union, and a third a member of the master plumbers' association, is the second conviction growing out of the recent investigation of the building situation made by the Lockwood joint legislative committee on housing. Attorneys for Hettrick and the other defendants have asked for a stay, pending application for an appeal.

Tax Exemption on New Homes Now a Fact in New York City

The Board of Estimate and Apportionment of New York City has approved the ordinance previously passed by the board of aldermen, exempting from taxation new homes and apartments for a period of ten years. The mayor has signed the ordinance making it effective at once. As noted in *Engineering News-Record*, Feb. 24, p. 362, the ordinance provides for an exemption of $10,000 for two-family houses and $1,000 a room for new apartments up to $5,000. To come within the ordinance, the buildings must have been constructed, or construction begun upon them, between April 1, 1920, and April 1, 1922.

Quotations Held No Indication of Market Conditions

That it is virtually useless to cite market quotations as indicative of real market conditions is the view held by E. H. Temple, Jr., construction manager, Aberthaw Construction Co., Boston, Mass. In the statement recently made, Mr. Temple asserts that dealers with heavy stocks on hand have given up all idea of securing old prices and are increasingly anxious to liquidate. He also believes that some contractors and fabricators who maintain shops which have expensive machinery and steady overhead costs are offering materials and service with contingencies and profits practically eliminated from price calculations.

Substantiating Mr. Temple's view of the present condition, he cites an operation in which his company recently engaged which called for incidental purchases of materials, dealers' quotations upon which ninety days ago were $13,000. Cash purchasing has since procured them for $9,635, a saving of 25 per cent. Though this amount is considered as insignificant in volume, its very insignificance makes the illustration widely applicable, asserts Mr. Temple.

As a result of the reduction in contractors' organizations to indispensable personnel, Mr. Temple finds that the efficiency of workmen has materially increased. In work now under way by the Aberthaw Construction Co., the making, erecting and stripping of forms show savings of 40 per cent over performance records in the past four or five years. Carpenter work as a whole shows savings of 30 per cent. However, those savings are noted in the operations of picked crews.

Cement Manufacturers Indicted

Alleged violation of the Sherman anti-trust law is the charge in an indictment handed down March 1 by the Federal grand jury in New York City against seventy-four corporations and forty individuals engaged in portland cement manufacture. The defendant companies represent 85 per cent of all production in the United States.

Analyses Made of Construction Companies' Incomes

One out of every three construction corporations in the United States operates at a loss according to analyses made of the latest income tax returns by the Associated General Contractors of America, and published in a special bulletin issued Feb. 26. The analyses further show that less is left for dividends in proportion to receipts, and that more is taken for federal taxes in proportion to income, than in any other industry. Construction is rated four times as hazardous as manufacturing and less than 20 per cent of construction corporations earn more than $5,000 net annual incomes. Eighty per cent of the total construction of the United States is carried on in the ten states of New York, New Jersey, Delaware, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Wisconsin and Michigan.

Steel Manufacturers Plan International Association

At a meeting in New York City last week, directors of the American Iron & Steel Institute, an organization which includes the leading steel companies in the United States and Canada, put into motion plans calling for the organization of an international association of steel manufacturers, the purpose of which will be the promotion of friendship and business co-operation in matters relating to foreign trade. According to Elbert H. Gary, who presided at the directors meeting, formal plans for such an international association will be presented at a meeting in October. Invitations will be sent to steel makers in all countries doing business with the United States, including the European nations, Japan, China, South Africa and South America.

Federal Agent to Ask Prison Terms in Housing Cases

Deputy Attorney General Samuel Berger has announced that he intends to ask that prison sentences be imposed on all persons convicted upon indictments found in connection with the Lockwood housing inquiry in New York City. His policy is a result of the conviction and sentence of Hettrick and others of conspiracy and coercion in the organization and operation of a code of practice in the plumbing industry. Approximately one hundred individuals and an equal number of corporations are under indictment as a result of the Lockwood inquiry. Fines only have been, so far, the penalties attached to the conviction of such defendants appearing in the Federal court.

Road and Miscellaneous Building Show Marked Activity

Receipt of bids and the award of contracts in road construction work, and an increase in the number and value of miscellaneous buildings upon which construction has begun, are

features of the past week in the contracting field. As noted in *Engineering News-Record* of last week, p. 361, the Pennsylvania highway department received bids for the construction of 100 miles of highways. Highway departments in both Colorado and Wisconsin let contracts during the week aggregating a quarter of a million dollars in value, and other states, including Connecticut and Illinois, are soon to receive bids for the construction of many miles of permanent roads.

California received bids Feb. 21 on highways the total low bid of which was more than $1,250,000. Ohio received bids on 35 miles of roads Feb. 25 divided among thirteen projects that will cost close to $1,250,000.

In analyzing the Pennsylvania bids, it is found that the average of the low bids received for the entire 100 miles is well over $70,000 per mile, one project averaging $100,000 per mile. Whether contracts will be let on these bases remains to be seen. However, such figures cover heavy excavation in many cases. The total of the lowest bids on the entire 100 miles was $7,373,317.

An increase in the amount of building construction, including educational institutions, theaters, apartments, stores, lofts, office and bank buildings, churches, etc., is noticed in the list of contracts awarded published in the construction news section of this issue. In thirty-five contracts awarded, the total cost is $10,238,000. Most of the money is to be spent in school construction, though a number of large apartment houses are in the list.

Other construction includes a $5,000,000 addition to the West Penn Power Company's plant at Springdale, Penn., the contract for which has been awarded to Sanderson & Porter, New York City.

Monthly Prices of Construction Materials

UPS AND DOWNS OF THE MARKET

LABOR—General decreases in Boston and Minneapolis, with labor universally plentiful. The January report of the New York State Labor Commission shows reduction in wage rate of from 5 to 33 per cent, with average weekly earnings for the month $27.61, against $28.35 for December.

PIG IRON—We show a general decrease of from $2 to $7.

PIPE—Clay drain tile has been declining all winter in New York, and the present price of 3-in. is $50 per 1,000 lin.ft., as against $61 last report. In St. Louis 6-in. and 8-in. drain tile are down $5 and $10 respectively. We publish a list of Pittsburgh prices of sewer pipes this month for the first time. Sewer pipe down in New Orleans and Atlanta. Cast-iron pipe down $3 in San Francisco.

ROAD OILS AND ASPHALT—Road oils down 1 to 2 cents in New York and Chicago. Asphaltum down in New York, Chicago and St. Louis.

WOOD BLOCKS—Down in St. Louis, New York and Minneapolis. Advances in Boston and New Orleans.

SAND, GRAVEL, STONE AND LIME—No change in New York crushed-stone prices, which are for occasional orders of moderate quantities. Down in St. Louis and Montreal. Sand down 25c. per cu.yd. in New York, 10c. in New Orleans, and increased in Boston and Montreal. Gravel down in New Orleans, Los Angeles and Atlanta. Hydrated lime (finished) up $3 in Montreal, common lump down in Minneapolis and Atlanta.

CEMENT—We show decreases in 17 cities.

REINFORCING STEEL—This month we show Pittsburgh mill price of triangle mesh instead of price with freight allowed to New York, as heretofore. Our New York prices include delivery, warehouse prices being 10c. less. Metal lath down in Chicago. To stimulate business independent steel companies have cut prices on reinforcing bars. We quote $2.25@2.35, the latter figure being the Steel Corporation's mill price.

COMMON BRICK—New York delivered price unchanged, with wholesale price still $18, sales having gone as low as $15, however. No brick coming into New York, and stocks are being depleted. Down in Denver, Minneapolis, Detroit and Atlanta.

HOLLOW TILE—Down in New Orleans and Atlanta. Change expected in New York by March 15.

STRUCTURAL MATERIAL—The independents are cutting the Steel Corporation's price, and we quote a range of $2.15@$2.45 for both structural shapes and plates. Decrease of 25c. in San Francisco.

ROOFING MATERIALS—We show a general decline in price of roofing materials. Prepared roofings are about the same as last month, except in the case of slate surface roofing, which is now $2.80 per roll, against $3.50 last month.

STEEL SHEETS—We show a range of prices representing the independents' and the Steel Corporation's prices, respectively, in Pittsburgh. Decrease in San Francisco and New York warehouses.

LUMBER—General decrease of $2 on rough Douglas fir in San Francisco. Southern pine down $2 in New York, which price is $1 to $4 below the quotations of the Lumbermen's Bureau. Other decreases in Boston, Denver and Atlanta.

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY

S means scarce; E, enough; P, plentiful

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor	Remarks
Atlanta	$0.90P	$0.70P	$1.00P	$0.30P		$1.00P	$0.25P	Atlanta—Labor plentiful, with construction very light.
Baltimore	1@1.25	.80P	.87½P	.46@.50P	$0.74P	1.00P	.30@.35P	Baltimore—Normal supply in all classes.
Boston	.90S	.90P	.90P	.60P	.60P	.90P	.55P	Boston—Bricklayers and plasters leaving town. Other classes of labor plentiful.
Cincinnati	1.25E	.90P	1.00P	.70E	1.00S	1.00E	.60E	Cincinnati—Considerable unemployment.
Chicago	1.25	1.25	...	...	...	1.25	1.00	Chicago—Labor plentiful but independent.
Cleveland	1.00S	.90S	1.00E	.57½E	.80E	1.00E	.57½E	Cleveland—All classes plentiful. New agreements May 1.
Dallas	1.00P	1.00P	1.00E	.60E	1.00E	1.00E	.50@.75P	Dallas—All labor plentiful.
Denver	1.25E	1.10E	1.10@1.18½E	.75@.81½E	...	1.15½E	.50@.50½	Denver—Approximately 25 per cent of building trades working. Master Builders' Association filed notice Feb. 17, with state industrial commission of intention to reduce wages of all building trades 20 per cent on March 17.
Detroit	1.25P	.85@1.00P	1.10P	.70E	1.10P	1.25E	.50@.60E	Detroit—Contracts to May 1. "Open shop" contractors have made 20 per cent cut in all classes. Unemployment increasing.
Kansas City	1.12½	1.00	1.00	.90	1.00	1.10	.75	Kansas City—We received no reports this month.
Los Angeles	1.25E	1.00	1.00E	1.15E	1.00	1.00	.50@.75	Los Angeles—More men than jobs.
Minneapolis	1.00	.80P	.80P	.65P	....	.80P	.50P	Minneapolis—We show a 20 per cent reduction, effective Feb. 21. Labor organizations have not yet accepted new schedule.
Montreal	.90P	.75P	.60P	.40P	.50P	.60P	.35	Montreal—Much unemployment.
New Orleans	1.00E	1.00E	1.00E	.65E	1.00E	1.00E	.50E	New Orleans—Building trade stagnant, owing to high cost of labor and materials.
New York	1.25	1.12½	1.25	.87½	1.12½	1.12½	.75@.80	New York—Agreement of Nov. 20, 1919, was modified as shown effective May 1, 1920. Excavators, 75c.; Concrete workers, 81½c.
Pittsburgh	1.50P	1.25P	1.12½P	1.00P	1.00P	1.25E	.80P	Pittsburgh—Conditions normal.
St. Louis	1.25E	1.25E	1.25E	.85P	1.00E	1.25P	.52@.60P	St. Louis—Hoisting engineers receive $1.37½ on double hoist. Plaster hodcarriers receive 94½c.
San Francisco	1.25P	1.12½P	1.12½P	1.00P	1.12½P	1.12½P	.81½P	San Francisco—Labor plentiful.
Seattle	1.12½	1.00	.87½@1.00	.87	1.00	1.00	.62½@.75	Seattle—very little building. 12,000 to 15,000 out of work.

Price advances are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$*32.00	$44 60
Southern Basic	*29.50*	42 80
Southern Ohio No. 2	*32.00*	43 80
NEW YORK, tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	*37.41*	47 65
Southern No. 2 (silicon 2.25 to 2.75)	*32.26*	47 70
BIRMINGHAM		
No. 2 Foundry	*27.50*	41 00
PHILADELPHIA		
Eastern Pa.	*31.54**	45 65*
Virginia No. 2	*55.11**	43 25*
Basic	*29.00†*	43 00†
Grey Forge	*29.75**	42 50*
CHICAGO		
No. 2 Foundry Local	*28.00@29.00*	43 00
No. 2 Foundry Southern	*35.42*	46 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	*29.96*	43 65
Basic	*26.96*	42 90
Bessemer	*28.96*	43 40

*F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh		Chicago	
	Current	One Year Ago	Current	One Year Ago
Standard bessemer rails	$45 00	$45 00	$45 00	$45 00
Standard openhearth rails	47 00	47 00	47 00	47 00
Light rails, 8 to 10 lb.	2 45@3 00*	2 585*	2 45@3 00*	2 585*
Light rails, 12 to 14 lb.	2 41@2 95*	2 54*	2 41@2 95*	2 54*
Light rails, 25 to 45 lb.	2 32@2 85*	2 45*	2 32@2 85*	2 45*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

		6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago	Plain	*$1.60*	$1 85
Chicago	Creosoted	*2.00*	*2.05*
San Francisco	Douglas Fir—Green	1 35	.96
San Francisco	Douglas Fir—Creosoted	2 70	1.92

Prices per tie at mills in St. Louis district:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0 80	No. 1	$0 60
No. 2	.90	No. 2	.70
No. 3	1.00	No. 3	.80
No. 4	1.25		
7x9x8 white oak			1.05
7x9x8 red oak (No. 4)	$0.80	No. 5	.87

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh				San Francisco
	Current	One Year Ago	Chicago	St. Louis	
Standard spikes, ⅜-in. and larger	$3 65@3 90	$3 35	$3 40	$4 87½	$7 75
Track bolts	5 50@6 00	4 90	4 60	5 75	8 75
Standard section angle bars	2 75@3 75	2 75	2 75	4 05	5 00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of Mar. 21, 1919:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
⅛ to 3	54 to 57½	41½ to 44	⅛	15½ to 25½	+1½ to 11½
			¼	19½ to 29½	1½ to 11½
			⅜ to 1½	24½ to 34½	8 to 18½

LAP WELD

2	47 to 50½	34½ to 38	2	20½ to 28½	6½ to 14½
2½ to 6	50 to 53½	37½ to 41	2½ to 6	22½ tp 30½	9½ to 17½
7 to 12	47 to 50½	33½ to 37	7 to 12	19½ to 27½	6½ to 14½
13 and 14	37½ to 41				
15	35 to 38½				

BUTT WELD, EXTRA STRONG, PLAIN ENDS

⅛ to 1½	52 to 55½	39½ to 43	⅛ to 1½	24½ to 34½
2 to 3	53 to 56½	40½ to 44		

	LAP WELD, EXTRA STRONG, PLAIN ENDS			
2	45 to 48½	33½ to 37	2	21½ to 29½
2½ to 4	48 to 51½	36½ to 40	2½ to 4	23½ to 31½
4½ to 6	47 to 50½	35½ to 39	4½ to 6	22½ tp 30½
7 to 8	43 to 46½	29½ to 33	7 to 8	14½ to 22½
9 to 12	38 to 41½	24½ to 28	9 to 12	9½ to 17½

8½ to 16½		
11½ to 19½		
10½ to 18½		
2½ to 10½		
5½ to + 2½		

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	44%	54@40%	45½@40%
2½ to 6 in. lap welded	39%	50@40%	41½@40%

	Galvanized		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	28%	40½@30%	30½@20%
2½ to 6 in. lap welded	24%	37½@27½	27½@17½

Malleable fittings, Class B and C, from New York stock sell at +60% list prices. Cast-iron, standard sizes, 15% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York					
	Current	One Month Ago	One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$73 30	$73 30	$70 30	$69 10	$66 70	*$92.65*
6 in. and over	63 30	63 30	67 30	64 10	61 70	*87.65*

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	*$50.00*	$35 00	$60 00	$50 00		$55 00
4	*60.00*	51 00	70 00	70 00	$90 00	65 00
5	*90.00*	65 00	90 00	90 00	115 00	84 00
6	*115.00*	90 00	*120.00*	110 00	150 00	110 00
8	*185.00*	130 00	*185.00*	160 00	250 00	181 00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Current Delivered	Pittsburgh Delivered	St. Louis	Chicago	San Francisco	Dallas
3	$0 24	$0 132	....	$0 15	$0 14	....
4	.24	132	....	.15	.175	?0 18
5	.36	198	....	.225	.21	....
6	.36	198	$0 17½	.225	.245	25
8	.56	308	25	.35	.35	35
10	.84	462	35	.525	.49	....
12	1 08	594	45	625	63	80
15	1 61	792	68	90	1 05	....
18	2 30	1 10	88	1 25	1 47	....
20	2 76	1 32	1 20	1 50	1.96	....
22	3 68	1 98	....	2 00	....	....
24	4 14	....	1 56	2 25	2 52	2 40
27	....	....	2 75	4 50	3 50	....
30	....	....	3 40	5 50	4.20	....
33	....	....	4 35	6 75	....	....
36	....	....	4 50	7 00	....	....

	3	5	8	12	24	36
Boston	$0 21	$0 315	$0 49	$0 945	$3 15	$8 7125
Minneapolis			42	77	2 45	5 66
Denver		Quotations not available				
Seattle			40	80	2 88	....
Kansas City		No prices obtainable				
Los Angeles	11*	.165*	.275	.585	1.65	....
New Orleans		*.165*	*.333*	*.561*	*2.15*	....
Cincinnati	.156	23	.36	.712	2 30	....
Atlanta	*11**	*.165**	*.275*	.42	*1.29*	....
Montreal, *delivered*	30*	45*	.70	1 35	4 50	....
Detroit	.138	2115	.329	.621	2 56	6 625
Baltimore, *delivered*	....	33	.51	.99	3 29	....

*4-in., 6-in., 30-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.08	$0 09
New York, 65% asphalt	(at terminal)	.07½	.09
New York, binder	(at terminal)	.08½	.10
New York, flux	(at terminal)	.07½	....
New York, liquid asphalt		.09	....
St. Louis, 40% asphalt		.11	.06½
Chicago, 40-50% asphalt		.06	.07
Chicago, 60-70% asphalt		.06½	.0725
Dallas, 40-50% asphalt		.10	.07
Dallas, 60-70% asphalt		.13	.08
Dallas, 75-90% asphalt		.15	.10
San Francisco, binder, per 42-gal. bbl.		15.00	2.25

ASPHALTUM—Price per ton in packages (350-lb. bbl., or 425-lb. drums, and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$30.00	$21.00
Boston	No quotations	
Chicago	28.50	21.00
San Francisco	21 50	15 00
Dallas	35 00	27 00
Seattle	27 50	
Denver		50@ 70
Minneapolis	36 95	27 15
Kansas City	40 00	32 00
St. Louis	50@ 52	
Baltimore	40 00	
Los Angeles	23 75	15 00
Montreal	37 00	
Atlanta	56 00	
Detroit	49 00	42 25
Cincinnati	36 00	27 00

PAVING STONE—

New York	5-in. granite	No quotations
Chicago	About 4x8x4 dressed	$3 40 sq.yd.
	About 4x8x4 common	3 05 sq.yd.
San Francisco	Basalt block 4x7x8	65 00 per M
Kansas City	Granite	3 65 sq.yd.
Boston	5-in. granite	4 20 sq.yd.
Atlanta	Granite	2 00 sq.yd.
Detroit	Granite, 2½ blocks per sq.yd.	107 00 per M
Baltimore	Granite	2 25 sq.yd.
Montreal	Granite	6 50 sq.yd.
New Orleans	Granite	3 00 sq.yd.
Cincinnati	Granite	3.25 sq.yd.
St. Louis	Granite	3.40 sq.yd.

FLAGGING—

New York	Bronx	$0 25	sq.ft.
	Manhattan, 4 ft.	26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	95	lin.ft.
Chicago	18 in. wide	70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 70c. for 5x16 in., 80c. for 5x18 in.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	Io	$3 5¼
New York	4	Io	3.52
Boston	3	Io	3 45
Chicago	4	Io	3 75@ 4 00
Chicago	3½	Io	3 25@ 3 50
St. Louis	3½	Io	3.05
St. Louis	4	Io	3.50
Seattle	4	Io	Off market
Kansas City	4	Io	3 00
Minneapolis	3½	Io	2.59
Atlanta	3½	Io	2 31
New Orleans	3	Io	2 93
New Orleans	3½	Io	3 42
New Orleans	4	Io	3 85
Dallas	4	18	3 90
Baltimore	3½	Io	3 75
Montreal	4	Io	4 90
Detroit	3½	Io	3 40

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
New York	$3 00	$2 25	$3 00	$2 25	$1.25	$1 25
Denver	2 00	1 80	1 80	1 80	1 60	1 40
Chicago	2 75	2 00	2.75	2 00	2.75	2 00
Kansas City	3 25	3 25	3.75	3 75	1.25	1 25
St. Louis	1 65	1 78	1 70	1 82	1.70	1 68
Seattle	1 50	1 25	1.50	1.25	1.50	1 25
Dallas	1 75	3 50	1.75	3.50	1.75	2 25
Minneapolis	2 00	1 50	....	1.35	1.00	75
Cincinnati	2 00	....	2.00	....	1.30	1 30
San Francisco	2 50	1 50	2.50	1.50	1.65	1 50
Boston, per ton	2 65	2 00	2.65	2.00	2.00	2 00
New Orleans	3.00	2 55	....	2.40	1.75	1 35
Los Angeles	1.45	1 50	1 45	....	1.30	1 00
Atlanta, per ton	2.88	2.25	....	2.25	1.50	1.15
Detroit	1 85*	2 50	1.85*	2.00	2.50	1 85
Baltimore, per ton	1 40	1 40	1.60	1.60	.70	.65
Montreal, per ton		1.15	1.75	....	1.50	1.40

*Sand and gravel sells for $1 50 to $2 50

† Kaw River sand is $1 75 per yd.

CRUSHED STONE—Price for cargo or carload lots is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 90@ 2 00	$1 85	$2 15	$2 00
Chicago	2 75	2 00	2.75	2 00
St. Louis	1.85	1 65	1.85	1.65
Dallas	2 25	2 90	2 25	2 90
San Francisco	2 50	1 50	2 50	1 50
Boston	3 00*(del)	3 00	3 00*(del)	3 00
Minneapolis	2 00†	1 50†	2.25†	1 60
Denver	....	3 75	....	3 75
Kansas City	2 35	2 25	2.35	2 35
Seattle (del.)	3 50	3 50	3 50	3 50
Atlanta	3 25*	3 10*	....	....
Cincinnati	2 30	....	2 15	....
Los Angeles	1 70*	1 50	1 80*	1 50
Detroit	2 00	1 75	2.00*	1 75
Baltimore	1 75*	1 50	1.75*	1 50
Montreal	2.10*	1 75	2.50*	2 00

* Per ton. † Limestone; traprock, $1 60 and $1 80 per ton for 1½ and ¾-in.

CRUSHED SLAG—Price of crushed slag per net ton in carload lots:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1 00	$1 00	$2 50	$0.90
Easton, Pa.	1 20	1 20	3 00	1.10
Buffalo, N. Y.	1 25	1 00	2 00	1.00
East Canaan, Conn.	1 25	1 35	4 00	1.10
Birmingham, Ala.	1 25	1 25	2 05	1.00
Toledo, Ohio	1 50	1 50	2 35	
Atlanta, Ga.	2 58	2 25		

LIME—Warehouse prices:

	Hydrated, per Ton Finished	Hydrated, per Ton Common	Lump, per 200-Lb. Barrel Finished	Lump, per 200-Lb. Barrel Common
New York	$21 00	$20 00	$3 50* at plant	$3.30*
Kansas City	27 20	26 20	2 50	2 40
Chicago	20 00	....	....	1 75
St. Louis	26 00	20 00	....	4 12½*
Boston	29 00	26.00	3 80	3.55
Dallas	....	25 00	....	2 50†
Cincinnati	19 50	17.60	....	2 10
San Francisco	25 40	22 00	....	2 25
Minneapolis	27 00	22 00 (white)	2 00	1.70
Denver	....	3 20 (bbl.)	1.00 (bu.)	....
Detroit	22 00	19 00	2 00†	1.80†
Seattle	27 00	....	3 25†	....
Los Angeles	30 00	30 00	3 00*	3 00*
Baltimore	24 00 (East)	....	....	13 00‡
Montreal	28 00	....	15 00‡	....
Atlanta	....	18 00	....	1.80†
New Orleans	....	22.50	2 70	2 50

* 300-lb. barrels. † Per 180-lb. barrel. ‡ Per ton.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosedale)	$2 80	$1 50
Kansas City (Ft. Scott)	1 60	1 75
New Orleans	3 36	2 52
Atlanta (Magnolia)	11 00 ton	1 90
Cincinnati (Louisville)	2 75	2 25
Boston (Rosedale)	2.35	....

PORTLAND CEMENT—Current prices are for barrels in carload lots, *without* bags, to contractors:

	Current	One Month Ago Without Bags	One Year Ago Without Bags
New York (del.)	$3 10	$3 10	$2 80
Jersey City (del.)	2 89	2 89	2 47
Boston	2.87	3 41	2 42
Chicago	2.17	2 37	2 00
Pittsburgh	2.17	2 42	2 05
Cleveland	2.43	2 73	2 32
Detroit	2.51	2 78	2 08
Indianapolis	2.31	2 61	2 27
Toledo	2.51	2 71	2 12
Milwaukee	2.39	2 59	2 11
Duluth	2.10	2 35	2 10
Peoria	2.43	2 63	2 12
Cedar Rapids	2.51	2 71	2 18
Davenport	2.47	2 67	2 14
St. Louis	3.40	3 45	2 20
San Francisco	3 09	3 09	2 63
New Orleans	3.60	4 20	2 36
Minneapolis (del.)	2.70	3 00	2 22
Denver	3.10	3 25	2 82
Kansas City	2 76	2 76	2 36
Seattle	3 10	3 10	2 78
Dallas	2 85	2 85	2 03
Atlanta	3 00	3 00	2 70
Cincinnati	3 32	3 32	3 00
Los Angeles	3 21	3 21	2 78
Baltimore (del.)	2 93	2 93	2 90
Detroit	2.33@ 2.41		
Montreal (including bags)	3.50	3 52	3 48

NOTE—Bag charge is generally 25c. each.

TRIANGLE MESH—Price per 100 sq ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

Style Number	Sectional Area per Ft.	Square Inches Width	Pittsburgh, Mill	New York, (Del'd.)	Chicago	St. Louis	Dallas	San Francisco
032	0.032		$1.03	$1.55	$0.98	$1.03	$1.11	$1.54
049	0.049		1.32	1.95	1.26	1.32	1.43	1.96
068	0.068		1.61	2.35	1.53	1.61	1.74	2.41
093	0.093		2.07	2.98	1.97	2.07	2.24	3.11
126	0.126		2.57	3.67	2.43	2.57	2.79	3.88
153	0.153		3.06	4.34	2.90	3.06	3.32	4.03
180	0.180		3.51	4.97	3.33	3.51	3.81	
245	0.245		4.64	6.52	4.40	4.64	5.03	
287	0.287		5.36	7.50	5.08	5.36	5.81	8.10
336	0.336		6.21	8.67	5.89	6.21	6.73	
395	0.395		7.20	10.03	6.83	7.20	7.81	

PAVING

036P	0.036		$0.79	$1.23	$0.76	$0.79	$0.85	
053P	0.053		1.12	1.68	1.06	1.12	1.21	
072P	0.072		1.41	2.08	1.34	1.41	1.53	
097P	0.097		1.82	1.76	1.73	1.82	1.97	
049R	0.049		1.12	2.08	1.06	1.12	1.21	
067R	0.067		1.49	2.64	1.34	1.49	1.53	
089R	0.089		1.82		1.73	1.82	1.97	

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	New York* Current Carloads	Chicago	St. Louis	San Francisco	Dallas
27	233	$29.20	*$29.50*	$32.00	$34.20	$32.75
26	250	31.00	*31.00*	33.00		34.50
25	300	32.75	*32.50*	35.00		36.75
24	340	33.65	*34.10*	37.00	42.70	39.25
22	450	35.50		40.00		43.30

*Delivered on job.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

In.	Pittsburgh Mill	Warehouse, Uncut: New York	Chicago	Dallas	San Francisco
½ and larger	$2.25@2.35	$3.63	$3.48	$3.87	$4.75@$6.00
⅝	2.30@2.40	3.68	3.53	3.92	4.80 5.05
¾	2.35@2.45	3.73	3.58	3.97	4.95 5.10
⅞	2.50@2.60	3.88	3.63	4.12	5.00 5.25
1	2.75@2.85	4.13	4.18	4.57	5.05 5.50

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ in. and larger	$2.50	*$2.40*	$4.25	½	$2.90	$2.65	
⅝	2.55	*2.45*	4.30	¾	2.90		
⅞	2.65	*2.50*					

BRICK—Contractors price per 1,000 in cargo or carload lots as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch	4-inch
New York (del.)	$22.70	$22.70	$25.00	$57.20*	$63.30*
New Orleans	25.50	25.50	22.50		
Chicago	15.00	15.00	14.00	37.00	
St. Louis, salmon	15.00†	15.00	16.00		
Denver, salmon	*14.00*	15.00	17.00		
Dallas	25.00	25.00	18.57	44.00	
San Francisco	18.00	18.00	15.00		44.38
Los Angeles	15.50	14.50	12.50	(not used)	
Boston (del.)	25.00	25.00	35.00	59.25*	66.25*
Minneapolis (del.)	*20@22*	24.00	20.00	*37.00*	43.00
Kansas City	22.00	22.00	20.00		
Seattle	19.00	19.00	15.00	48.00	53.50
Cincinnati	21@22	22.00	19.00	45.00	
Montreal (del.)	20.00	20.00	17.50		120.00
Detroit	*18.00*	20.00	21.00	46.00	52.00
Baltimore (del.)	20@25	22.50	20.00	38.00‡	42.00†
Atlanta	*18.00*	15.00			
New Orleans	24.00				

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Hard brick $20.50 in St. Louis. ‡Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots for hollow building tile:

	New York: Current on Trucks	One Year Ago	Chicago	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.2444*	$0.1667	$0.12	$0.125	$0.145	
6x12x12	.3259*	.2223	.18	.165	.21	
8x12x12	.4345*		.216	.215	.29	.379
10x12x12			.27	.28		.4739
12x12x12			.324	.32		.5684

* Partition tile. Less 5% for cash, 15 days.

	4x12x12	8x12x12	12x12x12
Boston	$0.173	$0.28	$0.43
Minneapolis	.121	.2117	.3314
Cincinnati	.125	.2	
Kansas City		No prices obtainable	
Denver		Quotations withdrawn	
Seattle	.13	.175	.30
Los Angeles	.11	.192	.23
New Orleans	*.18*	*.32*	*.45*
Detroit	.15	.27	.39
Montreal	.25	.31	.38
Baltimore	.16	.27	.45
Atlanta	*.10*	*.195*	

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York: Current*	New York: 1 Yr. Ago	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.15@2.45	$3.58*	$3.97	$3.67½	$3.58	$4.83
Channels, 3 to 15 in.	2.15@2.45	3.58*	3.97	3.67½	3.58	4.83
Angles, 3 to 6 in., ¼ in. thick	2.15@2.45	3.58*	3.97	3.67½	3.58	4.83
Tees, 3 in. and larger	2.15@2.45	3.58*	4.02	3.72½	3.58	4.83
Plates	2.15@2.65	3.78*	4.17	3.87½	3.78	5.03

*Deliveries in Brooklyn, New York and Staten Island 15c. per 100 lb. extra.

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York — Current	New York — One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3.00	$3.08	$6.00	$5.08	$5.17½	$7.05	$6.45

CONE HEAD BOILER

½ in. and larger	5.00	5.08	6.10	5.18	5.27½	7.15	6.45
⅝ and ¾	5.25	5.33	6.25	5.33	5.42½	7.40	6.85
⅞ and 1	5.50	5.58	6.60	5.68		7.65	7.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c. Tank rivets, 40 per cent off.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.25	$4.15	$6.00	$5.50	$4.20	$4.95
Cut		7.65	8.95	**6.85**	7.25	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

	New York: 1-Ply c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply c.l.	Philadelphia: 1-Ply c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply c.l.
No. 1 grade	$2.15	$2.55	$3.00	$1.90	$2.30	$2.70
No. 2 grade	2.05	2.45	2.95	1.85	2.20	2.60

Slate-surfaced roofing (red and green) in rolls of 108 sq. ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $8.00 per square in carloads, $8.25 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square of 100 sq. ft.) per roll	$2.80
Tar pitch (in 400-lb. bbl.) per 100 lb.	*2.10*
Asphalt pitch (in barrels) per ton	*49.50*
Asphalt felt (light) per ton	*98.00*
Asphalt felt (heavy) per ton	*102.00*

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York — Current	New York — One Yr. Ago
No. 10	*3.20@3.55*	$4.77½	$4.68	$6.75	*$4.68*	$6.80
No. 12	*3.25@3.60*	4.82½	4.73	6.80	*4.73*	6.85
No. 14	*3.40@3.65*	4.87½	5.03	6.85	*4.78*	6.90
No. 16	*3.50@3.75*	4.97½	5.13	6.35	*4.88*	7.00
Black						
*Nos. 18 and 20	*4.05@4.20*	5.65	5.80	*7.05*	*5.68*	7.30
*Nos. 22 and 24	*4.10@4.25*	5.70	5.85	*7.10*	*5.73*	7.35
*No. 26	*4.15@4.30*	5.75	5.90	*7.15*	*5.78*	7.90
*No. 28	*4.20@4.35*	5.85	6.00	*7.25*	*5.88*	8.00
Galvanized						
No. 10	*4.50@4.70*	6.20	6.35		6.25	9.00
No. 12	*4.60@4.80*	6.30	6.45	*7.85*	6.35	9.10
No. 14	*4.60@4.80*	6.40	6.45	*7.85*	6.35	9.10
Nos. 18 and 20	*4.90@5.10*	6.60	6.75	*8.15*	6.65	9.40
Nos. 22 and 24	*5.05@5.25*	6.75	6.90	*8.30*	6.80	9.55
*No. 26	*5.20@5.40*	6.90	7.05	*8.45*	6.95	9.70
*No. 28	*5.50@5.70*	7.20	7.30	*8.75*	7.25	10.00

* For painted corrugated sheets add 30c. per 1000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York — Current	New York — One Year Ago	Chicago — Current	Chicago — One Year Ago
Raw in barrel (5 bbl.)	$0.73	$1.87	*$0.76*	*$1.66*
5-gal. cans	.76		.99	*1.86*

WHITE AND RED LEAD—Base price per pound.

	Red				White	
	Current		1 Year Ago		Current	1 Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13 00	14 50	14 50	16 00	13 00	14 50
25 and 50-lb. kegs	13 25	14 75	14 75	16 25	13 25	14 75
12½-lb. keg	13 50	15 00	15 00	16 50	13 50	15 00
5-lb. cans	16 02	17 50	16 50	18 00	16 00	16 50
1-lb. cans	18 00	19 50	17 50	19 00	18 00	17 50

500 lb. lots less 10% discount; 2000 lb. lots less 10 2½% discount.

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than car-load lots.

	Lumber Prices in Yards at San Francisco			
	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$25 50	$ 26 00	$ 27 00	$ 28 00
3x6 and 8	26 50	27 00	28 00	29 00
4x4, 6 and 8	27 00	28 00	29 00	30 50
3x10 and 12	27 00	28 00	29 00	31 00
3x14	27 50	28 50	29 50	31 50
4x10 and 12	27 00	28 00	29 00	31 00
4x14	28 00	29 00	30 00	32 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$ 26 50	$ 28 50	$ 29 50
6x14	28 00	30 00	30 50
8x10	26 50	28 50	29 50
8x14	28 00	30 00	30 50

New York, Chicago and St. Louis

	Southern Pine				Yellow Pine	
	New York*		Chicago		St. Louis	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$51 00	$52 00	$51 00	$52 00	$55 00	$57 00
3x10 to 10x10	49 00	50 00	53 00	54 00	57 00	5 00
3x12 to 12x12	55 00	56 00	55 00	56 00	59 00	61 00
3x14 to 14x14	60 00	62 00	60 00	61 00	62 00	64 00
3x16 to 16x16	62 00	68 00	65 00	66 00	69 00	71 00
3x18 to 18x18	79 00	80 00	69 00	70 00	74 00	76 00
4x20 to 20x20			72 00	73 00		

* For long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.
Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20-Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P	Fir	Hemlock	Spruce	P	Fir
Boston	$49 00	$55 00	$56 00	$50 00	[$56 00	$58 00
Kansas City	51 00	51 25	51 25	51 25	60 00	51 25
Seattle		35 00				35.00
New Orleans	38 00				42 00	
Baltimore	65 00				75 00	
Cincinnati	40 00	42 00	50 00	56 00	45 00	40 00
Montreal	78 00	78 00	68 00	78 00	79 00	100 00
Los Angeles†		47 00	46 00			49 00
Detroit	Quotations f o b mills only					
Denver						
Minneapolis		44 00	40 00			44 00
Atlanta					40 00	
Dallas	45 00				55 00	

	1 In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P	Fir
Boston	$55 00	$60 00	$55 00	$55 00	$60 00
Kansas City	102 00	106 50	106 50	113 00	112 75
Seattle		20 50			23 00
New Orleans	65 00			40 00	
Baltimore	45@ 47 50			45@ 50	
Cincinnati	34 00	47 50	43 00	35 00	64 00
Montreal	75 00	77 00	70 00	82 00	82 00
Los Angeles		43 00	45 00		97 00
Detroit	50@ 50		43 00		
Denver					
Minneapolis		36 00	37 75		33 75
Atlanta	15 00			18 00	
Dallas		33 00		42 00	

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Boston	$0 41½	New Orleans	$0 51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½†
Cincinnati	33	Philadelphia	35
Cleveland	24	St. Louis	47½
Denver	1 35*	St. Paul	69½
Kansas City	81½	Detroit	33
		Baltimore	33½

Note—Add 3% transportation tax. * Minimum carload, 40,000 lb. †Minimum carload, 50,000 lb., structural steel only.

CONTRACTORS' SUPPLIES

STEEL SHEET PILING—The following price is base per 100 lb. f. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$3 00	$3 00	$2 55@$3 65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York
Hercules red strand, all constructions	15%
Patent flattened strand, special and cast steel	15%
Patent flattened strand, iron rope	List
Plow steel round strand rope	30%
Special steel round strand rope	25%
Cast steel round strand rope	17%
Iron strand and iron tiller	List
Galvanized iron rigging and guy rope	+17½%

San Francisco, Galvanized iron rigging and guy ropes +22½%.
Bright plow, 25% off.
Chicago, +17½ on galvanized and on cast steel.
Western and California territory, 25%; plow steel, 22½%; galvanized iron rigging and guy rope.
Montana, Idaho and Arizona, 20%; plow steel, 27½%; galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra, while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft.; ½-in., 6; ¾-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 [illegible]	Kansas City	$0 24
New York	21	New Orleans	21½
Chicago	21	Los Angeles	18
Minneapolis	21½	Seattle	20
San Francisco	19	St. Louis	21
Atlanta	26	Montreal	31
Denver	20	Detroit	[illegible]
Cincinnati	32	Baltimore	25
Dallas	29		

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb. keg of black powder.

	Low Freezing 20°c	Gelatin 40°c	Gelatin 60°c	Gelatin 80°c	Black Powder
New York		$0 33½	$0 36½		$2 80
Boston	225	2425	2825	$0 365	
Kansas City	2475	27	30	34	2 40
Seattle	1825	2025	2275	2950	2 60
Chicago	2225	2425	2675	335	2 50
Minneapolis	2222	2426	2682		2 80
St. Louis	245	28	315	3575	2 50
Denver	2250	2550	29	3325	2 70
Dallas	265*	275	3025		2 60
Los Angeles	22	27	32		3 10
Atlanta	2525	2875†	3225	3650	2 60
Baltimore	2525	2875	3175	36	2 10
Cincinnati	2325	265	2925		2 35
Montreal	30	32	37	38	4 10
New Orleans	255	275†	300†		2 80

* 30 Per Cent. † Low freezing.

PILES—For spruce and plain pine poles, delivered New York, the price is as follows:

Spruce 10-in. butts, 5-in. tops, length 20-30 ft.	$11 50
Spruce 12-in. butts, 6-in. tops, length 30-40 ft.	10 50
Pine 12-in. butts, 6-in. tops, length 41-50 ft.	18 75
Pine 14-in. butts, 6-in. tops, length 51-60 ft.	22 50
Pine 14-in. butts, 6-in. tops, length 61-71 ft.	25 25

	Dallas
6-in. x 20-ft.	$4 60
6-in. x 30-ft.	7 10
8-in. x 30-ft.	8 45
8-in. x 35-ft.	10 35

OLD MATERIAL—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15 00	$14 50	$14 50
Stove plate	15 00	18 00	17 50
No. 1 machinery cast	23 00	18 00	19 00
Machine shop turnings	8 50	7 50	6 00
Cast borings	9 00	10 00	10 00
Railroad malleable cast	13 00	15 00	14 00
Re-rolling rails	15 00	15 00	15 00
Relaying rails	45@ 47 50	42 50@ 47 50	35@ 40

SHIP SPIKES—Current prices per 100 lb.

In.	San Francisco— Galv.	San Francisco— Black	Seattle Black
½	$9 20	$8 50	$8 55
⅝	8 75	6 75	8 25
¾	8 60	6 60	8 30

Pittsburgh base, $4.50 per 100 lb.